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Journal of the Society of Arts.

FRIDAY, DECEMBER 11, 1857.

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EXAMINATIONS.

The following circular has been issued to the Institutions in Union with the Society :—

Society for the Encouragement of Arts, Manufactures, and Commerce, London, W.C., December 4, 1857.

Sir,—With reference to the Circular Letter of the 25th ult., and to the Programme of Examinations for 1858, which accompanied it, I am instructed to direct your attention to the *Journal* of this day, the 4th of Dec., which will be found to contain a full report of the proceedings of the Special General Meeting of the Society, held on the 1st inst.

You will see that the Bye-laws, passed in February last, the operation of which the Council had suspended, on the ground of their illegality, were revoked as illegal, and that the new Bye-laws which the Council proposed, to enable them to reconstitute a Board of Examiners, in conformity to the Charter, were unanimously adopted; and the following resolution was passed by a very large majority :—

"That this meeting, while it recognises the value of Oral Examinations, continues to have entire confidence in the Council of the Society, and entrusts to it the working out of the question of Examinations among the Institutions in Union."

For the reasons briefly stated in the Address of the Chairman of the Council which was delivered at the opening of the present Session, and appeared in the *Journal* of Nov. 20, the Council are convinced that it is quite impossible for the Society of Arts to examine orally, on any fair and satisfactory system, all the Candidates that may be ultimately expected to be presented by the Institutes in union throughout England, Wales, Scotland, and Ireland, when the system of examination shall have become fully developed; but the principle of Oral Examination, in combination with Examination by papers, has always been appreciated by the Council as highly valuable in those cases where it is possible to guard against the capriciousness and risk of unfairness which are obviously inherent in the Oral system.

If the Candidates for examination were to be few, and capable of being brought to a single centre, the Council would certainly have them examined both orally and by papers; but in the case with which the Council have to deal the Candidates ought in a few years to be counted by thousands, and they cannot afford either the time or the money which would be required to convey them to, and to maintain them at, places of Examination distant from their own homes and from the scenes of their daily labour.

The object to be aimed at by the Council is, that, throughout the whole Union, wherever there is class-instruction, the students of the classes should have the advantage of Examination. The funds contributed by the Institutes in Union ought to be so expended by the Council of this Society as to afford to all parts of the Union, as far as possible, an equal amount of advantage. It must be borne in mind that the Union comprises Institutes ranging from St. Austell to Aberdeen, from Margate to Belfast, and from Limerick, through Wales, to Lowestoft.

The Council had no little difficulty last summer in obtaining the services of even four gentlemen who were able to go from London to Huddersfield as Examiners; no one has as yet attempted to show to the Council by what means it could obtain the services of an adequate number of the Members of the Society's Board of Examiners simultaneously at the five places which were proposed: and the Council are quite satisfied that, even if five centres of Examination would meet the wants of the Union, which is obviously out of the question, it would be impossible for the Society of Arts to send simultaneously to those five centres the requisite number of Examiners adequately representing the authority of the Board and giving uniform judgments. It must also be remembered that the Oral Examination of such large numbers, simultaneously in many places, has not only never succeeded, but has never been even attempted; and that experience has abundantly proved that very large numbers can be well examined simultaneously at many places by written papers.

But there is still another difficulty—the difficulty of time—which involves also the difficulty of expense. A hasty Oral Examination is admitted to be the worst possible test; and every one can calculate for himself the length of time that would be consumed by the full and careful Oral Examination of the very large number of Candidates that ought ultimately to be expected if justice were done to all the Institutes in the United Kingdom.

These are only a few of the difficulties which make it impossible for the Society of Arts to extend the Examinations of its own Central Board otherwise than by papers. The Council, however, are of opinion that the previous examinations by the Local Boards may with advantage be conducted orally as well as in writing. Each Local Board, however, should determine this point for itself.

It has been alleged that men unable, or scarcely able, to write will have no chance of succeeding in an examination which is not oral. This is admitted; but it never could have been intended that the Society's Central Board of Examiners should examine persons who cannot write. The object of the central and final examinations is—not to provide for such exceptional cases, but—to promote the best possible education of the greatest possible number of persons connected with the Institutes in the Union. Writing is one of the first elements of education; and, as such, is properly to be tested by the previous examinations of the Local Boards. No Candidate who cannot fairly write ought to be presented to the Central Board.

It was stated, at the Special General Meeting, that, even in the great towns of Yorkshire, the Local Boards could not satisfactorily discharge the duties which the programme invites them to undertake, and that there would be suspicions of partiality, unless the local authorities were assisted by the presence of at least one member of the Society's Board of Examiners. The Council cannot entertain this idea. It is absolutely contradicted by the experience of Local Boards in Yorkshire, Lancashire, Cheshire, South Hants, Wiltshire, Devonshire, Berkshire, and London. The Council believe that there can be but few places where the formation of an efficient and impartial Local Board able to conduct a previous Examination would be really difficult. In all cases, however, where difficulties arise, the Council will do their best to assist in removing them, if invited by the local authorities to do so, by transmitting to any Institute an explanation in detail of what has been already done in forming Local Boards in various places; and, if necessary, concerting with the Institutes for sending an officer of the Society to assist them in organizing their plans.

By order of the Council,

P. LE NEVE FOSTER, *Secretary.*

FOURTH ORDINARY MEETING.

Wednesday, Dec. 9, 1857.

The Fourth Ordinary Meeting of the One Hundred and Fourth Session, was held on Wed-

nesday, the 9th inst., James Caird, Esq., M.P., in the chair.

The following Candidates were balloted for and duly elected members of the Society :—

Charles B. Clabon.
Joseph Farrar.
Eugene Rimmell.
John Edmund Willis.

Previously to the reading of the Paper, the Secretary called the attention of the meeting to some small working models, shown by Sir James Murray, illustrating the power to be obtained by gaseous pressure on the surface of liquids in close vessels, with a view to its employment as a force for drainage purposes, whilst the salts in the sewage are utilised for agricultural purposes, as referred to in Sir James Murray's letter in last week's *Journal*, page 47. Some further explanatory observations on this head will be found at page 65 of the present number of the *Journal.*

The Paper read was :—

ON THE PROGRESS OF THE AGRICULTURAL IMPLEMENT TRADE DURING THE LAST TWENTY YEARS.

By S. Sidney.

The paper which I am about to read this evening, is an attempt to trace the progress of the agricultural implement trade between the years 1837 and 1857. I say *trade*, because during the last twenty years the "progress" has been created and supported rather by a steady and increasing demand, which has led to important improvements in the details of the manufacture of agricultural implements, than by any extraordinary mechanical inventions, such as the Jacquard loom, the power loom, the self-acting mule, which have, from time to time, completely revolutionized the cotton and silk trades.

I have selected, and shall endeavour to confine myself to, the period that has elapsed since 1837, because, during that period, four circumstances, viz., the importation of guano, the manufacture of superphosphate of lime, and other artificial portable manures, the promulgation and general acceptation of Mr. Josiah Parkes' system of deep thorough drainage, the extension of the railway system, and the annual exhibitions of the Royal Agricultural and Local Agricultural Societies, have combined to raise to the mechanical perfection only to be obtained under the factory system, and to bring into common use a number of implements and machines which had long ago been invented and described in quarto volumes, some of which had been in use in one or two counties, but which, in 1837, were considered, if known by the mass of English farmers, as curious useless toys.

Let me state, at the commencement, that I am not about to read a paper on the use of agricultural implements, to the many first-class farmers who will probably be present, in spite of the attractions of the Smithfield Club dinner. I am not so impertinent and presumptuous as to attempt to teach those from whom, during the last fifteen years, I have learned almost all that I know on agricultural questions. My object is to afford to that large class, who get their meat from the butchers, and their bread from the bakers, without troubling themselves about the origin of either, some idea of the vast amount of mechanical ingenuity and agricultural experience which has been devoted, during the last twenty years, to making inferior soils fertile, and fertile soils more productive, to economising time and labour in every operation of husbandry, so as to keep pace, as far as soil and climate would allow, with the daily increasing demands of our town population. I feel sure that when you have followed me through my attempt to sketch the various mechanical aids which, within the period under notice, have been brought to bear upon the several operations of land drainage, the preparation of the soil for seed, the gathering of crops, and the preparation of crops for market, you will come to the conclusion that no standard manufacture has made more solid and rapid progress in England, within the last twenty years, than that of bread and meat.

I say England, because it is a curious fact that Scotland, which originated and adopted several cardinal improvements in agricultural implements fifty, and even a hundred, years before England, is now, in agricultural mechanics, at least, twenty-five years behindhand.

Scotch agriculturists make shift with barbarous implements, that have been discarded by all our best farmers; and where Scotch farmers use improved ploughs, drills, hoes, and threshing machines, they usually obtain them from English manufacturers.

With these preliminary observations, I will proceed to the subject of the evening, which I propose to treat, not chronologically, but, in the order in which the operations of modern agriculture are conducted.

Perhaps the greatest, certainly the most profitable, improvement of modern agriculture, is that obtained by deep drains, cut with tools and laid with porous earthenware pipes, which were practically unknown in 1845. In that year, at the exhibition of the Royal Agricultural Society, at Shrewsbury, a portable horizontal drain-tile machine, on a principle since become universal, was produced, which could make 20,000 pipe tiles in ten hours; two years previously, the first tiles exhibited had been made one at a time. In the following year, Mr. Parkes produced, at his Newcastle lecture on the principles of deep drainage, a set of the tools for cutting deep drains, which are still in use. The principles Mr. Parkes had been years considering, and maturing by experiment, but he rightly considered it useless to make them public until he could find a machine for manufacturing, with economy and rapidity, a suitable conduit pipe.

It is not necessary to enter here into the details of either the theory or the practice of thorough draining. It will be enough to state that with the help of tile drain machines and tools first made public in 1845-6, there have been, up to the present time, upwards of two millions of acres drained. By this process many hundred thousand acres of land previously in waste, or only fit, at best, for poor pasture, and many hundred thousand acres of retentive clays which could only bear corn in favourable dry seasons, have been brought into a regular rotation of arable cultivation, in which roots, the foundation of first class farming, take their place, and are even fed off by sheep.

Perhaps this is one of the most striking instances of great agricultural results from very simple mechanical assistance,—a clay pipe made by a machine that any labourer can work.

We will, then, suppose our soil rendered dry, porous and warm, better able to receive and absorb the fertilizing rain and atmosphere by a network of drains. The next work is to turn up the soil; to bury weeds deep enough to cause them to decay, so as to add to instead of exhausting the fertility of the soil; and to expose retentive soils to the mellowing influence of the winter's frost.

For this purpose we resort to the plough and the cultivator; spade digging is usually too slow, for even the horse plough is not fast enough to overtake the work that ought to be done before winter's rains and snow stop all autumn work.

It is not my intention to devote any considerable part of this paper to a consideration of the ancient history or modern curiosities of the plough—the most ancient and most universally useful of agricultural implements.

In the south of Europe ploughs are in use, even more primitive in construction than those employed by our Saxon and Norman ancestors, constructed either wholly of wood, or with the share armed with a thin point of wrought iron. And it must be admitted that, in a warm dry climate, on the light soil which alone is devoted to corn-growing, in thinly-peopled, semi-barbarous countries (barbarous, speaking agriculturally,) a very rude implement, of no great strength, is sufficient to effect the slight stirring of the soil required before the seed is carelessly broad-casted. Nature does the rest, and on such a soil a genial sun often produces crops exceeding in quantity and quality the best returns of the best cultivated fields in our humid and more rigorous climate.

In England, the plough is not only required to bury the weeds and stubble, but to cut, move, and turn over a damp tenacious clay soil, often covered with a thick tough skin, the result of a crop of artificial grasses trampled and eaten closely down by sheep.

Twenty years ago, when the Royal Agricultural Society of England commenced the annual exhibitions which form the more prominent, and, certainly the most useful part of their operations, there were two or three ploughs constructed on very good principles in use in two or three English counties, but it is a curious fact that even the plough makers had but loose, vague opinions on the comparative merits of the forms of the ploughs they manufactured. At that period, the Ransomes, of Ipswich, had been manufacturers of ploughs for nearly a century; they had introduced, at the beginning of this century, several substantial improvements, for instance, cast-iron shares, case hardened on the sole, which were not only much cheaper than wrought iron shares, but had the essential advantage of sharpening themselves when at work, because cast-iron sides wore away more rapidly than the case-hardened sole. But in the then state of agricultural intelligence and opinion, the Messrs. Ransomes made as many as eighty different kinds of ploughshares, of which some were good and some were bad, in order to accommodate the local prejudices of every county into which they sent travellers. At present, in common with all first class ploughmakers, they decline to make an ill-shaped plough to please any county or customer.

It would be impossible, within the limits of this paper, to describe the various kinds of ploughs that were in use, even amongst first-class farmers, in 1837. It will be sufficient, for the purpose of illustration, to mention that in a series of experiments instituted in 1839, by the late Henry Handley and the late Philip Pusey, two of the most intelligent founders of the Royal Agricultural Society, and in trials for prizes made at the meetings of the Society at Liverpool and Cambridge, in 1841 and 1842, the greater number of ploughs tried were of wood, with the exception of the share and the coulter. In several the mould board was also of wood. The greater number were swing ploughs, in which, being without wheels, the depth is regulated by the line of draught and the skill of the ploughman; some of them had one wheel, others had two high wheels, of equal size, and a cumbrous arrangement like the old wheeled ploughs of our Saxon ancestors, called " A gallows;" while two counties only, Bedford and Rutland, made use of ploughs with the two wheels of unequal size, of a model from which all the best ploughs in England at the present time have been constructed, and on which Messrs. Howard, of Bedford, have established their world-wide reputation.

On further examination of the details of the construction of the best ploughs produced in 1837, it will be found that the coulter, the wheels, and the other parts requiring occasional adjustment by the ploughman, were made fast by the clumsy expedient of wooden wedges. The well-shaped iron Scotch swing plough, and the well planned Beds and Rutland modern wheeled ploughs, were the exceptions twenty years ago. In almost every county there were to be found barbarous ploughs, of home construction, with wooden beam, wooden breast, wrought-iron share, and on the swing principle, with one fixed stilt and one loose stilt. Generally a hedgestake

" Contrived a double debt to pay—"

a handle for the ploughman and a spud with which at frequent pauses he cleared the share of adhesive clay, or poked down the furrow, which " would insist on rising" behind the breast of his plough.

In 1837, and, indeed, up to 1842, the principal English agricultural writers wrote and argued that the swing plough worked with less labour for the horses, that is, less friction, than the wheel plough.

At the present day, in all the best cultivated districts of England, the ploughs in common use are almost all constructed on the principles of the one exhibited on the floor, one of Howard's P.P. ploughs, with more or less excellence of detail, according to the skill of the manufacturer. For many years past, no other form has had the slightest chance of winning a prize at the trials of the Royal Agricultural Society, and I am not aware of any instance in which it has not been successful at local ploughing matches. In the last trial at the Royal Agricultural Society's show, at Carlisle, in 1855, the swing ploughs, which local prejudice still retains in use there, as it does in Scotland, were signally defeated.

In Paris, at two exhibitions, the English form of plough was found as superior in mechanical arrangement as in materials.

It does not fall within the plan of this rapid sketch of the history of agricultural implements, to describe every variety of the half-dozen ploughs, for different soils and purposes, which every first-rate farmer has in use. These may best be studied in the illustrated catalogues issued by each maker, or, better still, in the department devoted to agricultural implements at the Crystal Palace.

Within twenty years, the *subsoil plough* brought into notice by Smith, of Deanston, for stirring and sometimes bringing up the soil, between the surface and drains, has been established as a standard implement, and is manufactured by all our established plough-makers.*

Mr. Bentall has attained a high reputation for the broad-share plough which bears his name, which can be used either for paring away a stem of stubble and weeds immediately after harvest, or, with an alteration of its parts, as a subsoil, "Bentall's broad-share" being one of the few absolutely new implements produced since 1837.

The harrow is as old, if not an older implement than the plough. In Australia, after rudely ploughing the dry soil, the settlers sow their seed broadcast, and cover it with a harrow of bushes, made as much as possible after the directions of Gervase Markham, two hundred years ago, who tells his readers to " get a pretty big white thorn tree, which we call hawthorn, and make sure that it be wonderful thick, bushy, and rough grown," &c.

But a modern harrow is required for covering seed, for breaking the surface clods of rough ploughed land, for loosening the surface of the soil, and thus allowing the air access to the roots of the plants growing on it, and for gathering weeds to the surface.

On the Continent, where iron is made costly for the benefit of ironmasters, the harrows are entirely of wood. In the oldest English agricultural works in which harrows are delineated, we find the teeth of iron, and the frame work only of wood, and that was the construction almost universal before the exhibitions of the Royal Agricultural Society commenced, and for some years afterwards. At present harrows entirely of iron are extensively used, and are daily gaining ground in agricultural favour, not only in England, where they are, looking at their efficiency and durability, more economical than wooden frames, but even in France, in spite of the heavy protective duties on iron.

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* In the *Museum Rusticum*, 1766, a Mr. Randall, of York, advertises a set of subsoil ploughs, viz., " A loosening plough, that goes one foot deep without either mould or coulter, so as to cut the ground 18 inches wide, leaving the soil in its place.—A lifting plough, to gather the soil so loosened, and make a clear trench 18 inches wide, and one foot deep.—Another lifting plough, with a broad wheel under the plough, throws it upon what the soil had raised up before."—*Communicated by R. W. Blencowe, Esq., of Lewes, to the Editor of the Bath and West of England Journal.*

The form of iron harrow most esteemed is that first introduced by Messrs. Howard within the last twenty years, the form being zig-zag, with the teeth so arranged that each cuts a separate track at equal distances, and furnished with joints in the centre, which allow the frames to adapt themselves to the form of the ridges.

There is a century of agricultural progress between the continental wooden harrow and the simple, effective, durable iron zig-zag!

In addition to harrows, there are a number of powerful implements, under the names of scarifiers and cultivators, with curved tines of iron or steel fixed into a frame of wood or iron, which were known certainly twenty years ago, but which only became standard implements within the brief period that has enabled farmers of every county to exchange their respective opinions and experience. Among these Biddell's scarifier and Coleman's cultivator deservedly hold a high place. I mention them particularly, because, although the idea of such implements may be traced back nearly fifty years, their present form and materials, cast-iron frames, with wrought iron and steel teeth, are the result of mechanical facilities which have only been created within the period of progress sketched in this paper.

The soil having been ploughed and harrowed, and, if needed, scarified, or dragged, rollers come into use, either before or after the crop is sown, and here we again meet with striking instances of the advantages we enjoy from cheap iron and cheap conveyance.

To crush down the clods—"horses' heads" they are called by country folks—which *will* defy the efforts of ploughs and harrows, our fathers used rollers of wood and stone, and sledges heavily loaded, as the French and German farmers do still, and often employed labourers armed with heavy hoes, called in those times by the then familiar, now forgotten, name of clodders. Our rollers are now almost invariably made of cast-iron. A dozen iron rollers were exhibited by as many manufacturers at the Salisbury show in July last. The first invented, and the most celebrated and most universally effective is Crosskill's clod-crusher, which consists of "a number of cast-iron discs, of two alternate sizes, placed side by side upon a round axle, from five to six feet in length, so as to revolve independently of each other. The outer surface of each roller surface being serrated with a series of sideway projecting teeth, which cut perpendicularly in breaking clods."*

This roller is used, 1st. For crushing clods on heavy clay land. 2nd. For rolling corn as soon as sown on light land, so as to solidify it. 3rd. For rolling wheat upon light land in the spring, after frosts and winds have left the plants bare. 4th. For stopping the ravages of the wire-worm and grub. 5th. For rolling turnips in the rough leaf before hoeing, when the plants are attacked by the wire-worm or grub, and for many other purposes in this country and on the continent.

Crosskill's clod-crusher was invented in 1830, ten years before railways created agricultural travellers. It was by the merest accident that this valuable implement was not broken up for old iron, after being three times exhibited without obtaining any notice or honorary reward. But it was at length purchased, and tried by some score of enterprising agriculturists, the first being a clergyman, a cousin of the late Sir Robert Peel. Mr. Pusey published a chapter of testimonials to the value of the clod-crusher, and in the same year, when it was in full operation in many counties, the Society presented the inventor with its gold medal.

Having with the modern ploughs, harrows, scarifiers and rollers, reduced the soil, whether strong clay, rich loam, or light sand, to a condition fit to receive the seed, sowing is the next operation.

Twenty years ago the roots, in all but two or three of the more advanced counties, and nearly all the corn crops of England, were sown by hand, broadcast. The sower went forth to sow with a sheet, knotted into a bag, before him, and with an even swing distributed the seed over the land, where the regular furrows made by the plough were a great assistance in securing an even distribution of the crop. In those days, sowing was an act which was carried to extraordinary perfection; a clever broadcaster would broadcast fifty acres without making the difference of half-a-peck an acre.

More than a hundred years have elapsed since the ingenious and unfortunate Jethro Tull invented a machine for sowing corn in regular rows, for the purpose of admitting the use of his horse-hoe. Tull's system of cultivating by stirring the soil without manure, being only half a truth, failed, and his plans of mechanical cultivation fell into undeserved neglect.

Between 1782 and 1800 several drills were invented, the best, according to Mr. Allan Ransome (in his "Implements of Agriculture"), being by the Rev. James Cook, of Heaton Norris, Lancashire, which is delineated and described in the 5th volume of the *Letters and Papers of the Bath and West of England Society*, and bears a strong resemblance in outline to the modern drill.

But drills made no progress in public favour until turnip culture, with purchased portable manures, was introduced into Norfolk, in order to economise rape cake, the only artificial manure. One of the first used in Norfolk was invented by a blacksmith, for the father of Mr. Hudson, of Castle Acre, fifty years ago. Five and twenty years ago, the drill, manufactured then as now, by the since widely-known names of Garrett, of Leiston, Smyth, of Peasenhall, and Hornsby of Grantham, was scarcely to be found beyond Norfolk, Suffolk, and Beds, in a few counties where the Norfolk rotation had extended. The use of the drill spread in proportion as the use of artificial manures spread. Since 1837 an enormous trade and manufacture of portable manures, applicable to both root and corn crops, has been established, and the trade in drills has followed step by step the trade in guano, nitrate of soda, and superphosphate. At the late Exhibition of the Royal Agricultural Society at Salisbury, twenty-three exhibitors, from almost every agricultural district of England, appeared on the ground with drills adapted for every purpose and every kind of land, with from three rows to fifteen rows, able to deposit manure on one side or under the seed; to sow corn, turnips, mangold wurzel, clover, and small seeds; to broadcast artificial manures over growing crops; to wash in manures with water; to sow on hill sides; in fact, to meet every requirement of the farmer—the universal use of purchased manures having compelled the equally universal use of the economising action of the drill. Yet, in 1837, the drill was scarcely used out of Norfolk, Suffolk, and Bedfordshire. In 1851, it was difficult to find a man able to sow broadcast, and a Norfolk farmer has been obliged to invent a broadcasting machine for top-dressing corn with artificial manures.

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* In the *Museum Rusticum*, already quoted, Mr. Blencowe also finds in 1750 the rudiments of the spike rollers described by a correspondent, "A Young Farmer." This roller is of oak, 6 feet 3 inches long, 17 inches in diameter, hooped with iron at each end; rows of iron spikes are set in the quincunx order, at 6 inches distance one from the other in the rows, so that there are 13 spikes in one row, and 12 in every other throughout the circumference. The number of spikes is 225, projecting about 4½ inches. Every spike will weigh about 1¼ lbs. In the spring of 1752, I had 50 acres designed to be sowed with barley, when, the spring being dry and the weather extremely unfavourable, there was no such thing as preparing the ground for seed. I sent for workmen, and produced this useful instrument against next morning. On that morning a neighbouring farmer passed by us with half the country for clotters, as we were going to put our horses to the roller. He gazed on the roller, and went his way with the troop. They, after clotting two acres, returned the same way at night. Their master rolled his eyes all over a field of above 20 acres, saw it was perfectly fine, and after a pause said, "I was a good hedgehog for doing ten times more than his troop in one day, and ten times finer than a thousand clotters could in the same time.'

The horse hoe, to cut up weeds and stir the soil between roots or beans, follows the seed drill, as a matter of course, along the perfectly straight lines of vegetation produced by the machine sowing. The earliest horse hoe was Jethro Tull's, but that was a sort of plough, not the least like the invaluable implement which is identified with the name of Garrett, the "Inverted Horse Hoe," or the other horse hoes now in use.

The original of this implement is to be found in an inverted horse hoe, invented by the late Francis Blaikie, nearly fifty years ago, when agricultural agent of the late Earl of Leicester, to follow the rude drill already mentioned. This was one of the very many valuable contributions to agricultural progress made by Mr. Blaikie, while in the service of a landlord whose extraordinary exertions and extraordinary success in establishing a new system of cultivation, and in turning a waste of sheep walks and rabbit warrens into the best corn land of England, is familiar to every student of the agricultural history of England. The horse hoe does in time what no possible number of hand hoers could do at all.

The old form of plough horse hoes buried the plants; the modern horse hoes, whether inverted or of triangular shape, travel close between the rows, cutting up weeds and stirring the earth without doing the slightest damage, even when the rows are very near each other. One man and a boy, with this implement, can hoe from 10 to 15 acres a day, at a cost of about 6d. an acre. It was as little known as the drill, out of Suffolk and Norfolk, in 1841, when it was exhibited and rewarded at the Royal Agricultural Society's show at Liverpool. But, like the drill, the use of the horse hoe has received a much more powerful stimulus from the invention of portable root manures, and specially from Liebig's superphosphate of lime, in 1844-5, than from any number of exhibitions or prizes. It is not enough that an agricultural implement is ingenious; it must be profitable in time or money saved, if it is to be the subject of a great standard trade.

In the drill and the horse hoe, which have made such rapid conquests over agricultural manual-labour prejudices, since the age of railroads began, we find not only a saving of hand-labour that can be otherwise more usefully employed; not only a saving of time, so invaluable in our weeping uncertain climate; not only a saving of manure, too costly to be wastefully distributed, but a combined mechanical war upon weeds, which under the system of broadcasting, were often sown with the seed, and thus filled the place and exhausted the fertility due to food-producing plants.

As to the progress in the manufacture and sale of these twin implements of high-farming, I may venture to assert that there is not a respectable ironmonger in a country town in England, who has not drills and horse hoes on sale alongside of the ploughs and ploughshares, and harrows of the best model, if not the best manufacture.

Having thus far rapidly sketched the economy of time, labour, seed, and manure, which mechanical science and skill have brought to bear on draining, ploughing, harrowing, dragging, rolling, drilling, and horse hoeing, I will make a leap over the minor intermediate processes, and proceed to consider the present condition of the implements for gathering crops.

Here the improvement within twenty years is very striking and very rapid. Necessity, in this part of agriculture, left our farmers little choice. A frightful national calamity, in one year, swept away hundreds of thousands of haymakers and reapers, the pith and marrow of the itinerant bands of Celts who yearly crossed the Irish Channel to gather Saxon crops.

Farmers were slowly converted to the use of the best forms of iron wheeled ploughs, iron harrows, cultivators, scarifiers, drills, and horse hoes, by example, by speeches, and by reports, but it was the dearth of labour suddenly created, and unexpectedly maintained by famine, an enormous emigration, and war,—which forced the way for the progress of the haymaker, the horse rake, and reaping machines.

I shall not attempt to describe the several haymakers, all on the rotary principle, each of which, with the aid of the horse rake, does the work of forty men or women, making hay better and more quickly than the best disciplined hand-labour.

There are half-a-dozen makers, the names best known being those of Smith and Ashby, of Stamford, and Nicholson, who established a reputation at the Salisbury show this summer. All are founded on a plan patented by Robert Salmon, of Woburn, (an ingenious mechanic, patronized by Francis, the great agricultural Duke of Bedford,) in 1816. Salmon also invented the well-known excellent Bedford drill, and many other capital improvements in agricultural implements, but he was a quarter of a century before his time. There were too many paupers, too much surplus labour. Conveyance and coals were too dear in 1816. But his mechanical labours have since borne good fruit and done good service to the state; while more fortunate than many inventors, he was appreciated and rewarded during his lifetime by the nobleman who did for Beds what Thomas Coke, Earl of Leicester, did for Norfolk, and the first Lord Yarborough for the Wolds of Lincolnshire.

The first haymaker in the shows of the Royal Agricultural Society was exhibited at Liverpool, in 1841, by Wedlake, and rewarded with £3, but there was no great demand before 1850; since that date the demand has been, at every show, greater than the leading traders could easily execute.

Reaping Machines stand next in time and importance to the haymakers.

These, like so many other agricultural implements, were invented long before they were needed. The first working machine, like the drill, we owe to a clergyman, the Rev. Patrick Bell, who, for his amusement, invented the reaper now so well known as Crosskill's Bell. He made it, when a student, with his own hands, with the assistance of his brother and a country blacksmith, in 1828, and tried it for the first time in a shed, where he had planted stalks of corn, as children make gardens with cut flowers; then successfully in an open field; and, finally, for thirteen seasons, cut his father's crops.

But although Bell's reaper was rewarded by the Highland Agricultural Society, a quarter of a century ago, and worked on his father's and brother's farms for many years, it was not needed. Reapers and mowers were cheap, and clamorous for employment, so it lay forgotten in his brother's farm, until, at the Great Exhibition in 1851, an American, M'Cormick, exhibited a specimen of a reaper on a totally different plan to Bell's, which, under the strong pressure of necessity, had been invented, manufactured, and extensively sold in the thinly-peopled districts of the United States, for nearly twenty years. Another American quickly followed with the reaper, now so well known as Dray's, and, lastly, Bell's was exhumed from the obscurity of the Inchmichael Farm.

The American Reaping machine arrived at an epoch when the absence of the accustomed armies of itinerant Irish labour had not only raised the wages of hand-reapers and scythemen very considerably, but caused a delay of a very serious character in getting in ripe crops. Bell's machine was improved by borrowing one of the American knives, and other details. The American machines were altered and strengthened, in order to meet the requirements of the heavy English crops, and, after six years' experience, in Yorkshire, Lincolnshire, Norfolk, and Bedfordshire, during which the supply of itinerant labour has rather diminished than increased, it is safe to affirm that the three reapers named have become standard implements, for which there is a regular and increasing demand in all the best farmed districts of England and Scotland. When properly worked, with four horses and two men each, they clear off crops of wheat and other grain at the rate of from ten to fifteen acres a-day. Machine reapers not only enable farmers to get in the corn harvest without the assistance of wandering strangers, but also to make the most of snatches of fine weather, and to save time for carrying out autumnal cultivation, on which the success of root crops so intimately depends.

When a farmer engages a band of mowers and scythemen, he must cut right through his crops and lay the dead ripe and the half-green sections equally into sheaves, because his nomad assistants want to finish, and be away into the next parish, where they are expected; but with machine reapers the farmer can take advantage of an interval of fine weather, and cut from day to day just so much of the corn as may be ripe.

Hitherto the progress of the reaping machines has been delayed by the contradictory decisions of the Royal Agricultural Society, and by the weakness and imperfections in the workmanship of the machines manufactured during the years 1851-2, before the requirements of our heavy crops were fully understood; but during the harvest of 1857, the doubts of the most prejudiced were dissipated by the example and testimony of tenant farmers of high and well-deserved reputation, and henceforward Burgess and Keys M'Cormick, Crosskill's Bell, and the Dray's Hussey, which have all in turn been rewarded by the Society, must necessarily follow over the ground on which modern iron-wheeled ploughs, drills, horse hoes, and clod-crushers have preceded them.

I have now brought you as far as the Harvest Home. I shall not pause to describe the latest invention, Doctor Guyot's loom for weaving straw matting, which renders easy and rapid the important operation of thatching, or temporarily covering wheatstacks without the assistance of a professional thatcher, but I will proceed at once to the place where the last operation—threshing—is performed before the grain passes from the hands of the farmer into those of the manufacturer—the miller.

Within the last twenty years the whole system for preparing corn for market has been completely changed, by the inventions of our agricultural engineers. Not only has the flail been superseded by the threshing machine, and the horse-driven by the steam-driven threshing-machine, but the threshing-machine itself, instead of being a mere box for beating out the corn in a rough way, as it was less than ten years ago—leaving all the subsequent operations of winnowing, dividing, and dressing the corn to be performed on separate occasions by different machines—has now been so perfected and extended, that wheat is beaten out of the ears, and the straw carefully shaken, carried away into the loft while the grain is winnowed, the cavings separated from the chaff, the light corn from the best, and the light corn again divided into best-tail, light-tail, and whites, and the whole sacked and weighed ready for market. The last two operations are, it must be admitted, rarely practised except where one purchaser takes the whole wheat of a farm; because it is advantageous to dress all the corn of the same quality at once, in order to secure an evenness of sample; without this precaution the quality of each sack of corn would vary with the degree of ripeness or weight of each field or part of a field.

By the help of steam-engines, to which I shall presently allude, this complete transformation of wheat ricks into wheat fit for market and straw fit for use, on the farm, is performed at the rate of 100 to 150 quarters (800 to 1,200 bushels) per day, at the rate of 2s. 6d. per quarter.

To thresh and dress the same quantity by hand would cost 4s. per quarter, and occupy ten men from 160 to 240 days. The saving on the wheat crop of England, estimated at 12,000,000 quarters, would amount to £1,500,000.

Threshing machines, driven by water or horse-power, have been in use in Scotland more than a hundred years, and as soon as steam-engines became cheap in that country, they were employed instead of horse or water-power. A machine for threshing grain was invented and patented, in 1732, by Michael Menzies, a gentleman of East Lothian, on which the Society of Improvers in Scotland reported that "the machine would be of great use to farmers, both in threshing the grain clean from straw, and in saving a great deal of labour; for one man would be sufficient to manage a machine which would do the work of six." Other patented inventions for the same purpose followed, but it was Andrew Meikle, of Lymingham, East Lothian, the son of James Meikle, the same who in 1710 was sent over to Holland by the celebrated Fletcher of Saltoun, to learn "the perfect art of sheeling (i.e. winnowing) barley," who invented a threshing machine upon the same principle upon which the greater number of machines in use were constructed up to 1843.

But although twenty years ago a fixed threshing-machine, driven by horse, or wind, or water, or steam power, was to be found on almost every arable farm of more than 100 acres in the Lothians of Scotland, in England, where water-power was scarce, where leases with the security of tenure essential for the safe execution of fixed improvements were the exception, and, most (formidable barrier of all,) when under the old Poor Law, farmers were burdened with the support or compulsory employment of labourers who were nearly as tightly confined to the circle of the parish as if they had been mere serfs, *adscripti glebæ*, the soul-deadening, brain-stupifying flail was in full possession of nine-tenths of the barns and ricks. It is true that, more than half-a-century ago, a few great landlords had fixed threshing-machines, which are described by Arthur Young, and appear now very costly in proportion to the work they executed. An attempt, about the years 1829-30, to introduce portable horse-threshing machines into the south-western counties brought about incendiary fires and riots, in which not only the labourers, but respectable small farmers took part, and with which some of the higher classes were ignorant enough to sympathise. One small farmer was hanged for firing barns at Salisbury, in 1830. In 1857, the labourers, in sight of Old Sarum, cheered loudly on witnessing the success of the reaping machines.

In 1830, the greater number of farmers in the disturbed districts were frightened into selling their horse machines, and one of the now eminent agricultural implement makers bought back scores of machines at nominal prices.

When, in 1839, the Royal Agricultural Society held its first meeting at Oxford, horse threshing was slowly making way against the prejudices of the labourers, the farmers, and the squires. Even in 1847, the prejudice against machine threshing was to be found lingering among squires and great farmers, but necessity conquers all prejudices.

Under the old system of flail threshing, corn was beaten out for market not when required, but when the labourers of the farm had nothing else to do.

In wet weather, the very worst weather for so dealing with corn, the grain having previously been carted into the barn from the ricks, was knocked out on the floor, more or less dusty, with more or less success, according to the skill of the thresher and the state of the weather. On an average, as much grain was left in the straw as would now pay for steam threshing; for that reason fowls thrive better where the flail still survives. The grain mixed with the impurities of the floor, trodden on by the nailed shoes of the thresher, lay heaped up until the time came for hand winnowing, offering in hard times a strong temptation for each thresher to carry home as much as he could conceal for the use of his family or his pig.

No matter how pressing the demand of the market, the farmer could only realise his corn crops when the slow irregular manual work had been dragged through in an uncertain number of days.

After the riots there was an attempt to conciliate the prejudices of the labourers by hand-driven machines, but these were as hard to work as the flail, and in some counties the farmers returned to horse machines at the request of the labourers themselves. For English use, the portable steam-driven threshing machine has been invented, and although not equal, either in economy or efficiency, to fixed barn machinery, it is an invaluable machine, because it enables one machine to do the work of many farms, and enables the farmer to save carting by working at the side of ricks built on distant fields, and in the course of a day to turn from seven to eight hundred bushels of wheat into the next thing to cash, if a railway station lies handy. Portable steam driven machines have enlarged the trade of those local mechanics who do good service by hiring out what many farmers are unable to sink capital by purchasing. Less than seven years have elapsed since, under the influence of railways and the great annual fairs of the Royal and other Agricultural Societies, steam-driven threshing machines and barn machinery have been brought to their present perfect and economical condition.

As for flail-threshers, the difficulty in the best cultivated counties is to find a man who will consent to take a flail in hand. You must seek these antiquated instruments of stupefaction, either in very remote rural districts or in the metropolitan counties, Surrey, Bucks, and Essex, where, curiously enough, specimens may be found of the worst system of cultivation and the most barbarous implements. Shallow bush-draining—roots broadcasted—wooden breasted, one-stilted, swing ploughs, and flail threshing.

Having brought the principal crop of the farm into a marketable state, fit to be sent by rail to the corn-factor, to be pitched at market in bulk, or carried in those little calico bags in which the true British farmer keeps his corn-samples and his money; having shown how, within twenty years, every operation has been rendered more perfect in execution, more economical in money payment, and in most instances much more rapid, I must not conclude this faint sketch without saying something about the most modern and most important mechanical aid to agricultural progress—the steam-engine. Steam-engines were practically unknown on the farms of England twenty years ago; in the counties where they were most needed, the coal and the means of transport from the manufactory were alike wanting.

A portable steam engine (on the disc principle, which totally failed), was exhibited at Liverpool in 1841. Yet, in 1843, the manufacture and letting on hire of travelling engines to drive threshing machines, was mentioned by Mr. Pusey, in the Royal Agricultural Society's report, as having become a regular business, although "the Fire Insurance Companies charged an extra one per cent. where they were used."

In 1846-7 the demand for portable steam engines and threshing machines was so well established and steady, that a large capital was invested in erecting a great factory in Lincoln, for the sole purpose of manufacturing agricultural steam engines and threshing machines.

This establishment has, up to the present time, turned out upwards of two thousand steam engines, lately at the rate of five hundred engines per annum, and this great trade has been done without trenching upon the business of the half-a-dozen manufacturers who preceded Messrs. Clayton and Shuttleworth in that particular branch of the agricultural implement trade. In the catalogue of the show at Salisbury in 1857, I find not less than twenty exhibitors of fixed and portable engines, including the names of Hornsby, of Grantham, Clayton and Shuttleworth, of Lincoln, Barrett and Exall, of Reading, Cambridge, of Bristol, and the Ransomes, of Ipswich, whose names are all identified with the more important features of the mechanical displays of the Royal Agricultural Society. The continuous supply is the best evidence of the continuous demand—a demand created and supported by easy and cheap conveyance of iron, coal, manufactured machinery, and agricultural crops, and by a labour market which has, for the last ten years, been drained by internal and external migration from the rural districts to manufacturing towns at home, and colonies beyond the sea.

The agricultural steam engine is the essential adjunct of every well cultivated farm within the influence of a railroad and telegraph station. Under the charge of an ordinary farm labourer, an engine of from five to eight horse-power drives the barn machinery, cuts chaff or roots, crushes oats, grinds corn, pulps mangold wurzel, splits beans, saws wood, pumps water, and lends its boiler for steaming potatoes or roots, while men and horses are more usefully employed in other regular work of the farm. "And what," some of my auditors may at this point feel inclined to exclaim, "about steam ploughing?" Why very little this evening.

This subject so zealously investigated at the present moment is too large to be treated in a paragraph, but I will venture to state that the farmers of England, in this year 1857, are ripe and ready to receive and support a steam cultivator, which will perform its work as efficiently, if not as economically, as the threshing machine and the drill; indeed, it is not a substitute for horse-power that is so much required as a machine which can be used at a time and under circumstances when no number of horses could do the work required.

The cost of ploughing and cultivating easily or naturally drained soils is so low (from seven to fourteen shillings per acre), and is performed so efficiently with modern implements and good horses, that I confess I do not see, even looming in the distant horizon, any steam arrangement which, on light-land farms, is likely "to seal the doom of the plough," to use a favourite phrase of Mr. Mechi's; and this opinion of mine is shared by the most advanced agriculturists and the most distinguished engineers.

But there are in this country vast tracts of retentive adhesive clays which, in the best seasons, require an enormous amount of horse-power to work, and in wet seasons cannot be touched at all. No team is strong enough to draw the plough; no horse's foot can touch such soil without permanent injury. If a machine can be contrived which can be set to work the moment the crop is off the ground—when horses and men are most busy,—a machine which can execute its ten acres in daylight—if it can work on by moon-light or lamp-light, so much the better—then thousands of acres of first-rate corn-land, such land as is to be found in the Wealds of Sussex and Kent, in Dorset and Oxfordshire, can be turned up and cleared of weeds before Christmas, thus exposed to the mellowing influences of winter frost and snow, sown early in spring for root crops, and brought into regular rotation, which now for want of horse-power, or in consequence of a wet season, can never be touched until spring, and then grow as many weeds as roots or corn. A machine that would do all this would earn £1 an acre from a clay-land farmer. Towards this desired end Messrs. Fowler and Ransome, and Mr. Smith, of Woolston, have been working in a manner which holds out good hopes of success, and if they do succeed—not in cultivating well—that they have done—but in cultivating economically, they will increase the value of the arable land of the country as much as it has been increased within the last ten years by the promulgation of the cardinal agricultural improvement of this century, "Parkes's system of thorough-deep drainage."

I have not left myself room to say much about the simple yet invaluable machines for preparing food for stock—the root-slicer, pulper, and chaff-cutter. The first and last were invented in their present shape, before the epoch I have selected for illustration, for the use of the root-growers and winter feeders, in counties where grass and hay were scarce commodities, but their use has become within twenty years universal instead of local.

The demand for meat, and the extension of drill-root husbandry (the foundation of all of our high-farming) has raised the sale of the machines for economising cattle food from hundreds to thousands. That mutton and beef can be sold at less than famine prices—that we are not driven back to the salt meat of our ancestors—depends, more than ordinary town-customers of the butcher would believe, on the artificial manure which Liebig suggested, distributed by the drill, to nourish the roots, which, sliced by Gardner's famous machines, help to convert lamb into mutton at an age when it used to be lamb. The pulper for preparing roots for fermentation is a modern invention for carrying out a modern process of feeding without cooking.

Here my rapid and imperfect sketch of the progress of the agricultural implement manufacture since 1837 ends. It is not, you will observe, an account of antiquarian curiosities or mechanical toys, or of costly machines, only to be found on the fancy farms of wealthy landlords, but of the implements and machines which are for sale in every county, and almost every parish of England, which engage in their manufacture a fixed capital that cannot be estimated at less than one million sterling, which have called into existence, or raised from small beginings, at least six establishments, in each of which from 500 to 100 mechanics', and as much more steam-power are regularly employed.

When I remember what great factories are to be found in full work for the agricultural interest in Ipswich, Leiston, Bedford, Lincoln, Grantham, and Beverley, I feel justified in asserting that in spite of barren, undrained blanks of bad farming still to be found, there is no manufacture which has made more progress in proportion to the limits of nature than the British manufacture of beef, mutton, and bread.

Mr. J. Evelyn Denison (the present Speaker of the House of Commons), in his report on the Agricultural Department of the Paris Exhibition of 1855, made some calculations of the national expenditure and saving from the modern system of cultivation carried out by modern tools, of which I will avail myself, extending Mr. Denison's estimate to 1857, and, including some items he omitted. Within six years, upwards of ten millions have been invested by landholders in draining two million acres of land, on principles and with tools and pipes which were, practically speaking, not known and invented in 1845.

The difference in ploughing drained and undrained land Mr. Denison estimates at 2s. an acre (how much land is drainable, out of thirty millions under plough, I cannot estimate) but I believe the difference between the use of the best modern, and the old wooden swing plough, is at least 6d. more per acre.

An improved drill saves at least a bushel an acre in sowing, and gives a better and more certain crop; in fact, with artificial manure, which can only be usefully applied to a drilled root crop, secures twenty-five tons an acre on what would not have yielded five tons without the drill. At present prices, the saving of seed alone by the use of a corn drill, instead of broadcasting, would amount to full 1s. 6d. per acre on wheat, and 1s. on barley. The saving by the steam-driven barn machinery Mr. Denison estimates at 2s. 6d. per quarter for wheat, and 1s. 3d. for barley. In the absence of correct agricultural statistics, I must leave to others the task of calculating the total national saving obtained by the substitution of iron for wood, horse-power for man's power, and steam-power for horse-power!

But the greatest, the most important saving obtained by the use of the implements and machines produced in the factories of our agricultural engineers, is not in manual or even horse labour, but in *time*; hours, days, weeks—invaluable in our weeping uncertain climate, which were wasted and lost when the flail flourished and the drill was a curiosity, are now turned to profitable account. Land is broken up, seeds and manures are sown, corn is gathered, hay is made, grain is threshed out; within time and under circumstances that would have been as much out of the reach of the last generation of farmers as a journey from London to Liverpool in ten hours, or a sale in Smithfield of cattle feeding fat twenty-four hours previously near Aberdeen.

One word more before I bring to a close this long, and I fear wearisome paper, on the cause of the concentration, within the last twenty years, of the application to profitable uses of so many inventions, which were made and used by a select few in previous generations.

It is the fashion among a certain class of more respectable agricultural magnates to attribute this rapid progress to the prizes distributed at the shows of the Royal Agricultural Society; the pet phrase is, that "the Council have grown small blacksmiths into great engineers." An examination of the records of the Society induces me to doubt whether prizes have, on the whole, had a useful effect. In my opinion, they may at times be useful for directing mechanical invention into some new unexplored track; they may be useful where competitive trials are possible, by amusing and interesting the by-standing public and thus creating publicity; but they also cultivate a class of mechanical toys and complications which are not improvements. Prizes for the standard implements of agriculture, awarded after trials that decide nothing in the eyes of real farmers, are as absurd as prizes for printing presses or locomotive steam-engines. I understand rewarding a ploughman with a few pounds for personal skill, but not a ploughmaker who manufactures ploughs by the hundred.

The chemist who gave us portable manures,—the engineer who gave us railways and telegraphs,—who made coal and iron cheap and markets near,—who made Agricultural Implement Shows possible and profitable, and forced the stay-at-home race of farmers to travel in order to see with their own eyes and hear with their own ears; these created facilities and incentives to agricultural progress which could not be resisted,—these gave us "the three things" that Lord Bacon said, three centuries ago, "made nations great and prosperous,—a fertile soil, busy workshops, and easy conveyance for men and commodities."

DISCUSSION.

Mr. Bentall rose for the purpose of correcting a statement made in the early portion of the paper, with regard to the introduction of machinery for the manufacture of drain-pipes. He could testify to the fact that, forty years ago, Dr. Baker, of Malden Hall, in Essex, had a machine of that description in use in that district, which, according to the author of the paper, was in so backward and unenlightened a condition. He (Mr. Bentall) was, in fact, himself engaged in superintending the castings of a similar machine, in his father's foundry, as much as twenty-seven years ago.

Mr. James Howard thought that there was one point to which sufficient prominence had not been given, that was—that the great advance in agricultural machinery was not, in his opinion, so much attributable to the skill and energy of the machine-makers themselves as to the growing intelligence of the farmers, who, as they advanced in knowledge, felt the necessity for a better and higher class of machines, and the demand for that description of machinery had produced the supply.

Mr. Richard Garrett fully endorsed the opinion just expressed by Mr. Howard. With reference to the more recent improvements in drills, the name of Mr. Thomas Chambers, of Norfolk, should be especially associated with a machine for the distribution of liquid manure, and great improvements in that descriptions of implement were introduced by Mr. Chandler and Mr. Spooner. With regard to the horse-hoe, with which his own name had been connected, he would state that the only merit to which he laid claim, was the application of a lever to the hoes, so that each hoe acted independently of the rest, and adapted itself to the irregularities of the soil. The implement referred to by the author of the paper as having been in use forty or fifty years ago, and having been invented by Mr. Blaikie, was similar to that now so generally in use, only not having the separate adjusting lever.

Dr. MATTHEW TRUMAN differed from the author of the paper as to the utility of giving rewards for inventions. Although it might be difficult to trace the discovery of any great mechanical invention to the circumstance of a premium offered for that object, yet in the aggregate he regarded the giving of rewards for such purposes as of the greatest importance. It had struck him that one of the greatest defects of which they had to complain in the present day was the alleged impracticability of turning the sewage matters of large towns to profitable account for the purposes of agriculture. He believed that arose in a great measure from the want of proper stimulus to the investigation of the subject, in the shape of a commensurate reward. It was all very well to say that the reward would naturally accrue to the person who made the successful discovery; but in the absence of such an incentive as the offer of an adequate prize would afford, the matter could only be undertaken by the formation of a company, and it was well-known that, generally speaking, scientific men were the worst commercial men in existence; and there was little inducement for them to devote their time and energies to make discoveries of that nature. Many cases, however, might be mentioned in which the most striking results had followed the offering of premiums for important discoveries. Dr. Truman proceeded to illustrate this remark by an allusion to the high premiums offered by the great Napoleon for the successful introduction of the manufacture of sugar and gunpowder in France, at a period when all the French ports were in a state of blockade.

Mr. ROBERT BAKER had attended for the purpose of listening to what had proved to be a very able paper on the subject of agriculture, but he confessed, as an Essex man, he had not expected to hear the attacks which had been directed against the farming in that county. Taking the statement of Mr. Sidney himself, that his own experience in agricultural matters did not extend beyond a period of ten years, it was fairly to be presumed that he had not had much opportunity of investigating, at least from personal acquaintance, the farming of the different counties of England, much less, probably, that of Essex, which was a metropolitan county, for here the adage would hold good that a man knew less of what was passing around him than of what occurred at a distance. For that reason, perhaps, the author of the paper had formed some erroneous opinions with regard to the agriculture of the county which he (Mr. Baker) represented. Although, perhaps, he could not claim for the Essex people the title of the best farmers in the kingdom, they could, at least, enter the lists with any other portion of the country in the manufacture of agricultural implements and machinery. There was present in the room a gentleman who, he ventured to assert, represented a firm who had done as much for agriculture, in the shape of invention and manufacture, as any in the kingdon,—he alluded to Mr. Bentall. Mr. Sidney had dated all the improvements in the plough from the year 1837. The Messrs. Bentall had invented a plough, nearly or quite equal to that which Mr. Sidney appeared to regard as the model implement, fully 20 years before that date, and it had been extensively used in Essex. The Messrs. Ransome followed in the same course, and produced excellent ploughs even at that time. The case-hardening of one side of the share, gave the pre-eminence to the Essex plough. The old wooden plough had been gradually superseded by implements manufactured entirely of iron, but he was of opinion that in Essex there was as good ploughing forty years ago as at the present day. Although the implement was of a ruder character, yet it effected the object as well as the modern ploughs. Another very important point, was the comparative cost between threshing by hand and steam. He believed the farmers present would agree with him, when he asserted that the difference the author of the paper had asserted to exist between the two, was not borne out by practical experience. It had been stated, that wheat threshed by the flail, cost 4s. per quarter, whilst with the steam-threshing machine it was done for 2s. 6d. per quarter, and upon that basis, Mr. Sidney calculated a saving to the farmers of the country of a million and a-half of money. He (Mr. Baker) denied that statement *in toto.* There were persons in Essex who kept threshing machines to let on hire. One person had as many as six machines, in the neighbourhood in which he resided, and only last week an advertisement appeared, offering to thresh corn and perform the operations of dressing—all hands found—at 3s. 6d. per quarter—the farmer, he presumed, providing the coal for the engine—whilst it could be threshed by the flail and dressed for 2s. 6d. per quarter; and, therefore, flail threshing, though not so expeditious, was the cheaper of the two. He had not attended that evening with any intention or desire to disparage the use of these improved implements. He had always been an advocate for progress in agricultural machinery, and the first idea of the broad share plough was obtained from an implement which he (Mr. Baker) had brought out, the idea having been taken up and improved upon by Mr. Bentall. If, therefore, the farmers stimulated the manufacturers of machinery, he believed more would be achieved than had hitherto been done.

Mr. J. D. MAHON, having returned from a visit to several agricultural shows in Ireland, and the recent exhibition in Waterford, could state that there had been extensive displays of implements and machinery from all parts of England, and some from abroad. He thought the premiums offered at their shows had a beneficial influence. Ireland, not being a manufacturing country, had all these scientific improvements brought to her doors, and the Irish farmers were enabled to avail themselves of machinery brought from great distances, which, he was happy to say, they were now entensively using.

Mr. J. J. MECHI thought it very important that no misapprehension should exist with regard to the comparative expense of hand and steam threshing. He had used a fixed steam engine on his own farm for ten years, and, practically, he found that he could thresh his long-strawed mown wheat at 1s. 6d. per quarter, including every cost. In that respect there was a great discrepancy between the statement of his friend Mr. Baker and his (Mr. Mechi's) practical experience. Working with his machine, he could thresh 30 quarters per day, in which 16 men, women and boys were engaged, whose wages could be easily calculated, taking those of the men at 11s. per week, and the women and boys in proportion. The coals were at the rate of 1s. per cwt., about 10 cwt. per day being consumed; and, allowing the ordinary charges for the use of the machine, he could not put the expense at more than 1s. 6d. per quarter, making a difference of more than one-half between the calculations of Mr. Baker and the results of his own practice. He had even been given to understand that Mr. Hudson, of Castleacre, threshed his corn at an average of 1s. per quarter. Under these circumstances, he thought it ought not to go forth that hand threshing was cheaper than machine threshing. Mr. Mechi alluded to the great advantages which he expected to result from Halkett's guideway steam cultivator, upon a system of rails laid down on the farms, an important element of which was the facility with which the heavy root crops could be conveyed from stiff clay lands. He did not admit that Essex was at all a badly-farmed county. His opinion, from what he had seen, was that it ranked amongst the best-farmed counties of England, although, no doubt, the Essex people were surpassed in some districts of Bedfordshire and Lincolnshire in the quantity of food they produced.

Mr. Walford had noticed, with some interest, the remark made in the paper, that many important inventions and improvements in agriculture had emanated from clergymen, whilst the majority of improvements had not been introduced by practical farmers. It was singular that the farmers themselves should have made comparatively so few improvements in the implements which they employed; and, if clergymen had been instrumental in effecting these improvements, he apprehended they had done so by virtue of superior education. They must, therefore, look to the education of the farmers to make more rapid progress, and, at a time when so much attention was paid to the education of the tenant farmers, they might hope that the progress in this direction during the next twenty years would be far greater than that which had taken place during the period embraced in the present paper.

Mr. Thomas Scott said, the remarks of Mr. Baker suggested that it was necessary for gentlemen to rise up in defence of their respective localities. With respect to the north (from which the reaping and threshing machines had emanated) having been distanced by the south, he did not think the meeting would agree with Mr. Sidney. With reference to the system of agriculture in Scotland, he would state that it was hardly possible to go upon the premises of an intelligent farmer there, without finding a melancholy pile of discarded implements patented in the south; and they had before them the fact that, at all events, the Scotch system of agriculture realised good rents to the landowners, profitable returns to the tenants, and far better wages to the labourer than was the case in the south. With regard to steam threshing, he was of opinion, with Mr. Mechi, that with a fixed engine it could be done at 1s. 6d. per quarter, and on this matter he spoke from the results of experience over two thousand acres of wheat. He should like to hear from Mr. Baker, whether in Essex they paid the labourers sufficient wages to enable them to keep up the physical condition necessary for the hand labour which that gentleman appeared to advocate. He did not agree with Mr. Sidney, that the prizes of the Royal Agricultural Society had done little to stimulate the progress of the implement trade. Mr. Scott complained that the name of Tuxford, who had twice received the Royal Agricultural Society's medal, had been omitted in the paper, whilst the names of several eminent drill makers had also been unnoticed. Although he would not go to the length of saying that he regarded the plough as a doomed implement, yet, having seen its work on clay lands, he considered it one of the most clumsy inventions ever made, and there was an implement—as yet not mentioned—which he thought might well be substituted—the steel digging fork. During the last two years he had made experiments with it upon 200 acres of land, comparing not only the cost of ploughing, dragging, harrowing, and rolling, but also the results of the two operations. The price paid for digging with the fork was about £2 per acre. The land could be dug 10 or 14 inches in depth, as required, and he found the results much more profitable in all crops—especially green crops—than under the ordinary method of tillage, even with twice ploughing.

Mr. William Bennett, while expressing the interest he had derived from the reading of the paper, thought that the author had endeavoured to prove too much. The use of the drill had not been confined to the last 20 years. He had used a drill 40 years ago, and about the same period this implement was in extensive use in Norfolk. Four out of five farmers in that county employed the drill as early as the years 1819-20. He thought the saving by steam threshing had been put at too high a figure, although it was, doubtless, a great improvement, and might be more largely employed with advantage. Under ordinary circumstances he did not think the difference would be more than 6d. or 9d. per quarter. To farmers who were anxious to realise their crops speedily, the steam engine was unquestionably a great boon. He hoped his remarks would not be regarded as in opposition to the use of steam in farming operations, but he thought Mr. Sidney had put the case too strongly. He had used the wooden-breasted plough 45 years ago, and had then gained a prize cup from the Bedfordshire Agricultural Society. With regard to the fork digging mentioned by Mr. Scott, he could only say he should be sorry to do such work at £2 per acre.

Mr. Mechi said, with the steel fork a labourer would earn full wages at that rate of pay.

Mr. Scott added that some of his men earned twenty-four shillings per week by it.

Mr. William Day, as a consumer of bread and meat, and therefore interested in the price of those staple commodities, would be glad to hear from some of the practical gentlemen from the country how it was that, with all the late mechanical and scientific improvements in agriculture, the price of bread and meat had continued so high.

Mr. Durrant Cooper said, he wished to state his experience as a joint proprietor in steam-threshing apparatus, in what was considered at one time the worst part of Yorkshire. The steam-engine and threshing-machine had been employed there with the most satisfactory results. The wheat was threshed at a cost of from 1s. 6d. to 2s. per quarter. Moreover, wheat dressed by the steam-machine always bore the preference, amongst millers, to that threshed by hand labour. At the same time, those machines might not be attended with equal profit on small occupations, and on that point he did not go quite to the extent of Mr. Mechi's opinion.

Mr. Mechi remarked that no farm of 300 acres ought to be without a steam-threshing machine.

Mr. G. H. Ramsay thought that this subject, so ably treated in the paper, had been of great use to the agriculturists; and whether the improvements mentioned dated from 1836 or 1856, was, in his opinion, a matter of small importance. There had been, for some years past, a great and increasing demand for all kinds of agricultural produce; and he thought that Mr. Day was unreasonable in asking that meat should be sold at a less price than it would fetch in the market. If a population was doubled in the course of a century, notwithstanding a vast quantity of hitherto waste land was annually brought under cultivation, he could not understand how the increased demand was to be met. Upon the subject of steam-threshing, gentlemen from the same county did not agree to the saving effected, one placing the cost at 1s. 6d., and the other at 3s. 6d. per quarter. He could do his own threshing at 2s. per quarter, and he considered that an excellent price. There was an association in the north of England, by whom the work was done at 2s. per quarter, and a good dividend was paid upon the capital invested.

The Chairman, in closing the discussion, said he was sure they must all have been interested by the able manner in which Mr. Sidney had treated this subject, and by the manner in which it had been treated by those who had taken part in the discussion upon it. He thought they were open to a great deal of instruction from their grandfathers, and he felt indebted to Mr. Bennett for having shewn them that 40 or 50 years ago people did know something about the plough. No doubt the great improvements effected in the manufacture of that implement had cheapened the cost of production, and although they had passed through four prosperous years for agriculture, they would yet require all the economy that the intelligence of agricultural implement makers could bring to bear. Foreigners attended our agricultural exhibitions in large numbers, and were large purchasers. The machines were thus taken abroad to compete with the English farmer. They would, therefore, see the necessity of doing all in their power to improve their own productions. As to the charge brought against the agricultural community by Mr. Day, that the price of meat did not keep pace with the improvements in agriculture, he begged to say that it was not the fault of the farmer that meat was at its present price, but the fault of the consumers themselves, who had increased in a greater ratio. With regard to the criticisms in which Mr. Sidney had indulged, it was some consolation to him, to find that three of the most important machines—which had conferred such great benefits upon English agriculture—viz., the horse hoe, the reaping machine, and the threshing machine, were all the inventions of Scotchmen.

Colonel Challoner had great pleasure in proposing a vote of thanks to Mr. Sidney. Had time permitted, there were several points in the paper which he could wish to have touched upon. The great question of the present day in agricultural matters was the advantages of steam ploughing and steam threshing machines. It appeared to him that the great advantage of the application of steam power to matters of that kind, was where farming was carried on upon a very large scale, and where labour was deficient. He did not agree with Mr. Sidney in his disapproval of the plan of giving rewards for the invention of implements of real practical utility. The Royal Agricultural Society, after a great deal of consideration, thought so much of the necessity of endeavouring to apply steam to the cultivation of the soil, that they offered a premium of 500 guineas for an implement to turn over the soil, as nearly as possible, upon the same principle as was effected by the spade in hand-labour, and many such machines had been produced. The Society had been the originators of a vast deal of mechanical talent. They had shown the agricultural machinist the machine that was wanted, and he hoped the time was not far distant when this great agricultural desideratum would be realised.

The vote of thanks was then seconded by Sir James Anderson, M.P., and carried unanimously.

Mr. Sidney, in reply, said, he had not attempted a history of invention, but a history of trade, which was the most certain evidence of agricultural progress. He had not intended to make an attack on Essex, but he stated an undeniable fact. Within a few weeks he had been hunting in Essex, and had there seen wooden swing ploughs, with a hedgestake spud stilt, turnips broadcasted and drained with shallow open ditches, and farm buildings where the manure was put on a heap to drain into the ponds. He was not going to defend the steam threshing machine against the flail; that question had been decided by the farmers of England against Mr. Baker, for they had purchased thousands of machines, and were purchasing more every day. As to the Council of the Royal Agricultural Society, there could not be the slightest question that the great landlords, of which it was virtually composed, had rendered essential and invaluable services to agriculture by their great exhibitions, and the zeal for agricultural improvement which they had cultivated by precept and example, but an analysis which he had recently made of the prize-sheets of the Royal Agricultural Society for seventeen years, proved that, while a long series of useless toys had been rewarded, such valuable improvements as Bentall's broadshare, Coleman's cultivator, Crosskill's clod-crusher, Chandler's liquid drill, Richmond's chaff cutter, Gardner's root slicer, and others equally important, had been fully established among farmers before they received any reward from the Society. He maintained that the time had come for reserving prizes for great and much-needed inventions or improvements, such as steam-ploughing.

The Secretary announced that on Wednesday evening next, the 16th inst., a paper by Mr. John Underwood, "On the History and Chemistry of Writing, Printing, and Copying Letters, and a new plan of taking Copies of Written and Printed Documents, Maps, Charts, Plans and Drawings," would be read.

Home Correspondence.

APPLICATION OF THE SEWAGE OF TOWNS TO AGRICULTURE.

Sir,—Having lately, in company with Messrs. Moll and Mille, Commissioners from the Minister of Agriculture in France, and some French agriculturists, made a tour to places where the sewage of towns is applied to agricultural production, and visited a number of farms under the liquified manure culture, I am in a position to deal with some serious misrepresentations made by Mons. Barral, a French journalist, the editor of a publication called the *Journal d'Agriculture Pratique*, contained in an anonymous paragraph, extracted from a weekly newspaper, and inserted in the Society's *Journal*, No. 253. As displaying obstructions to science created by objectionable modes, as I deem them, of treating such questions—as well as a matter of justice, I must claim attention to some answers which I think it due to give.

M. Barral puts forth a statement, in relation to incidents of two farms, as affecting the whole principle of culture; the one, a farm at Myer Mill, near Ayr, owned by Mr. P. W. Kennedy, the Manager of the Branch of the Royal Bank of Scotland, and Provost of Ayr; the other, the small farm at Canning-park, occupied by Mr. Andrew Telfer, a merchant, at Ayr, who deals specially in manures.

The paragraph speaks of the "ruined farm" of Myer Mill, and M. Barral states that, "the ruin of Mr. Kennedy, of the liquid manure farm of Myer Mill, Ayrshire, has produced a very unfavourable opinion of the liquid manure system among the farmers." The Mr. Kennedy here mentioned, it is to be presumed, is Mr. James Kennedy, the former manager, a cousin of the owner, who, I was informed, left Myer Mill in consequence of an offer, on highly advantageous terms, of a farm on Sir Robert Peel's estate; and so far from Mr. James Kennedy believing the system to be a failure, he had stipulated for the appliances requisite to carry it out on his new farm. We did not find the new tenant at Myer Mill Farm, but we were informed that, instead of the farm being stopped, as represented, the present occupier was only waiting for the repair of the steam-boiler, and other changes for its conversion from a stock-feeding to a dairy and cheese-making farm, for which the superior quality of the milk attested there, and attested generally at other farms, as being obtained from the produce of liquified culture, would particularly suit it; and specimens of the new cheese were given to us and pronounced to be of high promise.

It was only in the exercise of great courtesy that Mr. Kennedy, the owner, could be prevailed upon to answer inquiries touching in anywise upon representations which he could not but disdain for their want of accuracy, and despise for their ignorance; but he informed the commissioners of the fact, which in itself answers the representation of the ruin of the farm,—that it had been let to the new tenant at double the rent previously paid for it; the improvement, however, comprising new buildings and other works, as well as the new distributary apparatus. Mr. Kennedy further stated, confidently, that if he had to do the work over again, he would make no material change in it, nor would he restrict the distributary apparatus, even over those portions of the farm possessing falls suitable for the distribution by shedding; for the method by shedding had been tried and found to be too slow, and the expense of steam power, instead of being large, was really small, as part of the entire operations. Moreover, that mode of irrigation confined the operation to grass cultivation, which was a serious loss. An intelligent agriculturist, who held the farm after the first manager, had declared, after a ten years' experience, that he did not see that the farm could be advantageously altered.

It may here be mentioned that on another large farm, —that of Mr. Harvey, near Glasgow,—where the distribution is from tanks on the hill tops, by shedding from pipes as by water meadows, but without any expense of surface formation whatever, the tenant declared that he now believed that he should double the effect of his manures if he were to distribute by the jet, in the manner in use at Mr. Kennedy's farm at Myer Mill; and, on a proper examination, without his declaration, it is clear that he might do so; for whilst by the method of the water meadow the surplus manure runs away into the ditches to great waste, the method of distribution requires four or five times more manual labour or time.

Instead of reducing the application of steam power and machinery, as proposed in the case of applications on a large scale, on account of their supposed expense; instead of returning to a method of distribution which occupies the surface for weeks,—from twelve to fourteen days, with from two to three inches deep of liquid, as I am informed by the engineer who laid out Sir Stafford Northcote's catch-water meadows, referred to as models,—the manager of Lord Essex's farm, for the application of the sewage of Watford, and Mr. Worsley, the owner of the land irrigated by jet with the sewage of Rusholme, expressed the opinion that the present occupation of time in distribution, even by the jet, during hours, might be advantageously abridged, and they would prefer augmenting the application of steam power, on account of its assured economy. Instead of its being true that the operation of the Works at Myer Mill had prevented the application of the new principle being followed elsewhere, the commissioners were invited to see one farm in that part of the country, where new works on the same principle are in progress, and several subsequently completed, and they have received a list of thirty-two new farms where new works have been completed, and got into full operation by Messrs. Young, mechanical engineers, at Ayr, since they executed the Works at Myer Mill.

In respect to that part of the paper in which Mr. Barral gives his own account of Mr. Telfer's verbal description of his farm, which Mr. Barral adduces as showing misrepresentation on the following points, in what he calls the official report of the Board of Health:—

"1. The subterranean irrigation system is only applied to half the farm, consequently the cost per acre," he says, "is just double what the Board of Health report states."

"2. No account is taken in the official report of the enormous application of guano, at the rate of 8 and even 16 cwt. per acre. Thus the estimated profits must be reduced by the cost of the guano, about £486 per annum."

Now, if M. Barral has himself read the document from which he professes to quote, which, for his sake, I must presume to doubt, he cannot but have been aware that he was not quoting from the report of the Board of Health, but from one of eighteen appendices, comprising the accounts and views of his Royal Highness Prince Albert, of M. De Candolle, of Bousingault, an account of the irrigations at Milan, by Count Arrivabene, the estimates and plans of different inspectors, not one of whose differing particulars has he any right to assume, in the absence of a distinct recognition, that the Board adopts more than any other. Incidentally, as illustrating the superior quality of irrigated produce, mention is made that Mr. Telfer obtained two pence per pound more than the current price for his butter, but no estimate is given, nothing is said in the Board's report about his profits, or about the profits of any one else. Whilst in the one account of Mr. Telfer's farm—mis-quoted as the Board's—that of Mr. Lee (for there is another account given of the same farm by the Hon. Dudley Fortescue,) the cost of iron pipes is stated at £2 10s. per acre; in the Board's minutes of information, the cost of "iron pipes and steam power" is stated at £4 4s. per acre,—whilst examples of other plans and charges are given from £3 2s. 6d. to £6 5s. 5d., with different plans, sizes, and lengths, and the prices of pipes, &c., so as to enable any one to form estimates for himself. Indeed, Mr. Lee's paper contains plans and estimates, as well as accounts of different farms and scales of expenditure, such as would correct any mistake made in one item of account of the particular farm selected from the rest, and unwarrantably held forth as if it were one particularly selected, and presented as a general example in respect to the expense of works. Any important error in the account of this particular farm, is due to Mr. Telfer himself, who, I was assured by Mr. Lee, had stated to him, at the time of its publication, that it was in the main correct, and who certainly, in his correspondence with me, never took any exception to it; nor, in the first instance, specified the extensive use of guano or artificial manures, if he did use them extensively at the commencement of his working with the new machinery. It might indeed at that time have been naturally overlooked, for the main question then was not as to the distribution of any one species of manure, but of every species of solid manure, in suspension or in solution in water. The charge against the general Board, couched, by inuendo, against myself, of having ignored the use of guano, and ascribed the whole of the production there to the common farm-yard manure, will be found to be of the same character as the rest of the representations in the paragraph.

If any competent or impartial person will read over the official minutes of information, he will perceive that the main question there treated is, as to the relative economy and efficiency of a new mode of mechanical distribution, in solution or in suspension in water, of solid manures of all sorts, of solid town manures, of solid farm-yard manures, and of guano, as well as diluted urine. By this new machinery, to use the illustration of Mr. P. W. Kennedy, "the land becomes loam, into which we put the raw materials, out of which the crop is manufactured;" and it was shown that it was applicable to almost any species of materials, even to mere sands, of which Mr. Telfer's farm furnished an important example. At page 58 of the Board's minutes, the conditions for the best application of liquified manures, are specified, and it is observed that "farmers who have observed none of these conditions in the application of guano, and have laid it on in bright "windy" weather, have had their manure evaporated by the ship-load, and their money blown away. They have then reported that guano did not answer on their land, and so with other manures. The ordinary effects of guano, Mr. Kennedy states, have been doubled by distribution in solution in water at the right times, by the new distributing apparatus, &c.

In respect to Mr. Telfer's farm, I will call the attention of M. Barral to the following passage, from the statement I made at the Congress at Brussels, and re-published in England, where it could scarcely have escaped the attention of his informants.

"In answer to some general observations of mine on the great advantage the system of liquified manure farming appeared to me to offer under the climate and soil of France, Mr. Telfer, writing to me in May, 1855, says, "I am fully alive to the advantages France possesses over this country in temperature, the most important element in vegetable life. With a moderate temperature all that remains to be supplied is manure and moisture, food for the plant in suitable form. This the system of pipeage enables you to furnish in exact accordance with the requirements of the plant. I am satisfied liquified manure could be successfully applied to grain crops in such a country as France, whereas here, from the uncertainty of the weather at harvest, it is accompanied with greater risk. Had I been favoured last year with dry weather during the time my wheat crop was ripening, my yield would have been 100 bushels the Scotch acre," (1¼ English), " or upwards of 85 hectolitres the hectare, instead of being confined to a small piece of the field that did not lodge, but on it the average of the field was a high one, 85 bushels. This high average is in some measure to be attributed to the thorough admixture with the soil of the various manures which had been applied in former crops by means of pipes. I am supplying ammonia this season entirely through my pipes, and at one-half the cost I did formerly, as the article can only be used by those who have pipes. I find the supply of manure must be in proportion to your command of moisture, the one being of little use without the other."

" On this I have to observe that whatsoever may be the remaining risk in England in the cultivation of cereals under this method, it is now proved, on various of the new farms to be less than the risk there under the ordinary method. Count Gasparin gives an instance of the production of 70 hectolitres of wheat per hectare in France, but he gives it as—a feat. Lord Kinnaird tells me that he has had as much grown on a farm belonging to him in Scotland, as a feat. In this feat of Mr. Telfer he used, as I understood from him, in addition to his farm-yard manure, a large proportion of guano, and his easy advance is due to the new instrument for its distribution in solution as liquified manure; but in other farms, which I think the most important examples, 40 and 45 bushels are given without any foreign or other liquified solid stable dung or diluted stable urine as manure."

Neither would a statement which I made at a meeting held at the Royal Agricultural Society, on the 15th of April, 1855, have probably escaped the notice of M. Barral's informant. In the course of that reported statement I observed, " I have visited the farms of forward and successful agricultural improvers during the last year and the year before, who have put their farms under tolerably complete distributary apparatus, who were still using guano or other artificial manures, whilst they had near the cattle sheds heaps of decomposing dung, which ought not to have been there but in dilution, and incorporated in the soil, and whose liquid manure tanks were stinking with the escape of the products of decomposition, denoting the waste which is preventible by putting the manure in its right place, *i.e.*, the soil. One eminently successful improver is a guano merchant, and is to be excused for displaying to the farmers a liquified application on his farm of the powerful effect of his commodity. Another farm manager has also excusable prepossessions in favour of special manures, which he has been moved to try. But the opinion, evidence, and the particular examples to which I advert, justify the objection which I make to the addition of any imported stimuli by the managers, whilst the farmyard itself presents, in the unused dung and in the products of decomposition evolved from the stagnant contents of the tank, the demonstration of the presence" (and escape) " of unused or misused manure."

On the testimony of horticulturists practically experienced in the application of liquified manures, I felt justified in applying these observations to such management as that of Myer Mill, by Mr. James Kennedy, as well as to the management of Mr. Telfer's farm, in the condition in which they were on the occasion of previous visits. The fact stated by Mr. Mechi, that the state of the water in distant water courses has denoted the days of his applications of liquid manures, is, I apprehend, a demonstration that he applies it wastefully, and that even he has yet to learn to do justice to the principle by more frequent applications, better adjusted to the absorbent powers of the soil. If Mr. Telfer had intended to make such statements as M. Barral reports, *e.g.*, " the liquid manure is only used to wash in the guano. Mr Telfer considers that its fertilising powers were very slight;" Mr. Telfer observed, " It is only a vehicle for guano; what there is does no harm, but it is quite insignificant;"—Mr. Telfer would have justified the supposition that he, as the chief salesman of guano, and of the artificial manures used within the district, was exalting the powers of the manures he could sell at the expense of those he could not sell. In accepting and putting forth such testimony, to the effect that the liquified manure of 50 head of cattle was of little or no effect, *presque rien*, when applied to 50 or even to 25 acres, could the editor of the *Journal d'Agriculture Pratique* have been aware of the experience of Belgium and Switzerland as to the powers of such manure? Can he have been aware of the recited experience and expositions of Schwerz, on liquified applications of manure, above all of the expositions of his own great countryman, De Candolle, who was, I believe, the first scientific agriculturist to enunciate the conclusion which I cite in his own terms:—" It is to be desired that the practical use of liquid manure, which serves at one and the same time as manure and for watering, should become more universal and popular in a great part of Europe?"

But Mr. Telfer authenticated by his signature a declaration to the Commissioners (much to the same purport, as I understood it, as his letter above cited), that he held no such conlusion as that attributed to him by M. Barral; and he at the same time stated that the account given of the operations of his farm by Mr. Morton, the editor of the *Agricultural Gazette*, was correct, and authenticated by himself before its publication. Now that account is, on the whole, higher than the one given by Mr. Lee (except in its statement as to the quantity of guano, not then specified by Mr. Telfer), which is the subject of Mr. Barral's attack. The intrinsic ignorance implied in such alleged testimony as that above attributed to Mr. Telfer, is only equalled by that implied in the like reported testimony of the owner and of the occupier of the farm at Rugby—that the excreta of a population of some five thousand persons, when conveyed in water, had very little fertilising power! How greatly the testimony of Mr. Walker, the owner, must have been misrepresented, I showed by the testimony of Mr. Walker's own authentic declaration. What the occupier may have said of the manure, in his position of a buyer, I cannot say, but I have a note of his evidence in respect to the value of the manure for sale to a neighbouring farmer, given to Mr. Alfred Dickens, the Inspector of the General Board of Health, on the occasion of an occasional visit by the President, the Right Hon. W. Cowper—" Mr. Campbell pays Mr. Walker at the rate of four shillings per 9,000 gallons; Mr. W. finding pipes, labour, &c. Mr. Congreve," the present occupier, " stated, that to produce the same results with ordinary manure, as those produced by the sewage," as was understood, for a quantity of some four inches, or less than one-third that applied in most of the greater examples of applications of sewage, " would require about twenty loads of the ordinary muck, the cost of which, and putting in, &c., would be about £10 per acre. Mr. Walker said he thought that about 100,000 gallons per acre cost £2, and he puts that sum against £5, which he estimates as about the cost of an ordinary top-dressing."

To any one whose own state of knowledge, applicable to the particular subject, is so low as to render him incompetent to judge of the intrinsic value of any testimony upon it, and to cause him to be held in doubt by contradictions of any kind from any quarter, I repeat that he may easily determine for himself the value of all conflicts of testimony, by trial works, which he may at little trouble and expense make for himself on his own farm, or in his own garden, by taking equal quantities of stable manure or any other manure, applying one portion in the solid form in the manner of the ordinary top dressing; by putting the other portion in solution in four or five times its bulk in water, and applying the solution to the land by the watering pot, and following up the growing crop, with food in water, in such quantities, and at such times, as a good gardener may advise. But the increased fertilising power of manures applied in solution or in suspension in water, and at once conveyed amidst the soil, and put in chemical combination with it, or applied as food to the growing plant, I must assume to be a general elementary fact or principle, placed beyond dispute, by a concurrent mass of testimoney from horticulturists, and from agriculturists at home as well as abroad. The new general elementary fact or principle which I have caused to be established, is a mechanical rather than an agricultural principle,—is the cheap as well as rapid means of applying the fertilising power of liquified or diluted manures or simple water; the power of doing almost for shillings, what by the gardener's watering-pot can only be done with the same rapidity, on the same scale, for pounds.

This elementary fact may be, as it is, evaded; but it is beyond the power of any engineer, however eminent, or of commissions, to gainsay it, unless to their eventual disgrace. The other new elementary facts established, are the power of removing sewage or liquid manure, and of applying it to the soil before advanced stages of decomposition arise, and its permanent retention by the soil in chemical combination.

As I stated the other day at the Public Health Section of the meeting, at Birmingham, of the National Association for the Advancement of Social Science, the progress and position of the question, as applicable to the relief of towns, has close analogies to the progress of railway communication. As stated by Charles Knight, "the earliest railway for public traffic in England, was one passing from Merstham to Wandsworth, through Croydon, a small single line on which a miserable team of lean mules or donkeys might be seen crawling at the rate of four miles an hour, with several trucks of stone and lime behind them. It was commenced in 1801, and opened in 1803, and the men of science of that day,—we cannot say that the respectable name of Stephenson was among them" [Stephenson was then a brakesman at Killingworth]—"tested its capabilities, and found that one horse could draw some thirty-five tons at six miles an hour, and then with prophetic wisdom declared that railways could never be worked profitably." Later on, when a locomotive was seen conveying goods at a rate of more than twenty miles an hour, at a cost of three-eighths of a penny, or less than a halfpenny per ton per mile; or, in other words, when the elementary fact was demonstrated of the practicability of public conveyance more than six times quicker and six times cheaper, than the common method, the cry was still the same, in the face of the demonstration, that it would never answer. And no doubt there have been apparent justifications for their prognostications,—but totally independent of the elementary facts,—as in double and treble expenditures, &c., beyond what is now proved might have sufficed. Lord John Russell has stated that it takes a quarter of a century to get a new simple idea into the public mind of England. In a quarter of a century, when the elementary fact or idea of the cheapness of railway conveyance did get into the mercantile mind, and became established and properly considered, and had superseded all mere opinion evidence, the chief direction of opposition,—and that, too, in the guise of superior wisdom,—was to supersede the first successful plan, not by anything more simple, but by something more complex and obviously dearer, as by substituting the performance of the one engine running, by a multitude of engines which were stationary, by rope or chain, or by atmospheric or hydraulic traction.

In respect to the distribution of town and farm-yard manures, and simple water, the elementary mechanical fact has been established of a power of distribution relatively as cheap and as quick as the railroad compared with the common road conveyance; upwards of 100 tons being proved to be distributable within an hour, at a less expense than two shillings, and this elementary fact has been presented in varied demonstrations with engines of different power, chiefly small, all excelling the common method in rapidity and cheapness in distributions at a mile of distance, from a penny to a halfpenny per ton; but in the face of these demonstrations, there are men of scientific position who declared that it could not be worked profitably, that is to say, that it would not answer to do that for pence which is now done for shillings, or to do that in an hour which now requires a day.

The opposition made to the application of this engineering element, to the distribution by jet, on the ground of its expense, reminds me of a story told of the late Duke of Bedford, that having urged upon one of his farmers who was ploughing with four horses in line, that as good work might be done with two horses properly yoked abreast, the farmer boldly denied the fact; on which the duke got off his horse, unyoked the team, dismissed two, attached two abreast to the plough, took it in hand himself, and did good work with it; to which practical demonstration the farmer's answer was, "that it might be all very well for his grace, as a duke, to work in that way, but he, as a farmer, could not afford it." This was a farmer of the old school; but here we have the editor of a scientific agricultural journal accepting a story as a fact, and proclaiming it to Europe, that a farm had been ruined by a plan which saves all the liquid manure previously wasted—had been ruined by works which, at a expense of 10s., effect a distribution of 40,000 gallons per diem, or, with the labour of one man at the engine, and a man and a boy at the hydrants, regularly effect a distribution of upwards of eighteen tons of liquified manure per hour, about a mile distant;—as much as would probably be distributed within the same distance, within the same time, by some hundred of men by the Swiss method of distribution with the *dossier!* His dealing with the established elementary fact, or principle of the fertilising power of such manure, really is of the character of one presented to the notice of the Commissioners, in connexion with the farm of Mr. Harvey, the great dairy keeper, near Glasgow, where the urine from the cow-sheds alone sufficed to raise a very large farm to a degree of fertility exceeding almost all others in the same district, and enabled him to sell the whole of his dung to other farmers, of whom we were informed that, notwithstanding the visible demonstration made from year to year of the fertilising power of the liquid manure, most of the farmers who bought the dung were unaffected by the visible demonstrations, and continue to allow the liquid manure produced on their own farms to continue to run to waste into the ditches and watercourses.

Notwithstanding the imperfections of the first works,—some of which, I must confess, present examples in respect to execution of the like humble grade as that of the first railway example at Croydon,—the primary elementary principles in question have been so far advanced that, as in the case of the early railway progress, the chief efforts in the way of opposition are as respects the town manures to obtain substitutes more complex in principle and more costly in application. Under the new system of tubular drainage, now extensively completed in many, and in progress in some hundred towns, all refuse is at once removed, without stagnation, without deposit, before it can enter into any advanced stage of decomposition, and before noxious emanations can be evolved; and it is demonstrated that, after constant removal from beneath the sites of houses and towns, it may be even more rapidly applied to agricultural production. In the two working examples of Rugby and Watford, the refuse discharged into the house drains at eight or nine o'clock, will, under ordinary circumstances, be upon the land before ten or eleven o'clock, and not merely upon the land in mechanical suspension, but incorporated in the soil, in effectual chemical combination; not merely deodorised, but disinfected. As in the case of the first lengths of railway traction brought into complete operation,—competent and disinterested persons who duly considered them, would see in them the demonstrations of the most extensive applicability, so in these examples of the application of town refuse to agricultural production, no doubt would be entertained that, by the application of the like means, the whole of the morning's refuse of the metropolis might be put in constant removal at the rate of some three miles per hour, and would be inoffensively incorporated in the soil before the nightfall;—that all the necessary works, internal and external, to achieve this result, might be accomplished considerably within the expense required by the official referee's plan of outfalls, to throw the whole of the refuse of the metropolis into the sea.

But the new elementary facts are far too simple for popular, or even, it would seem, for professional appreciation; and greater complexity, more so called "art and genius," and works of greater expense are required. Instead of discharging the refuse from the houses of the poorer and middle classes, it is sought to retain it in *fosses mobiles inodores.* Failures and nuisances in the course of abandonment in France are re-invented and re-patented in England, and agitation is maintained for their introduction. It being thus proposed that the excreta shall be retained in the houses in a decomposing state, deodorizers and disinfectants are to be used, and every house is to have its chemical manipulations with one of the chemical agents: and the conflict is, which it shall be,—whether peat charcoal, sulphite of zinc, or sulphite of magnesia shall be manufactured on immense scales of expense and profit. In respect, however, to house drains, short lengths, with good falls behind the houses, are too simple and too cheap;—kitchen floors are to be ripped up, the front pavement and road-ways are to be broken through for long lengths of drains with bad falls; prolonged divisions of the drains, which increase friction, are preferred, and, even where tubular branch sewers are adopted, sizes are frequently used for two or three houses which would serve for two or three hundred. In the face of the demonstrations of the complete self-cleansing powers of sewers of sizes and shapes properly adjusted to the flow of the sewerage, such large sizes and rough formations are maintained, so as to increase the friction, retard the flow, occasion deposit, and create extended cesspools. Then there are necessary arrangements for intermittent flushings, besides demands and projects for the extensive use of deodorizers and disinfectants to check and mitigate the products of decomposition; elaborate but unsuccessful trappings to protect houses and streets against their escapes, and calls for the construction of immense ventilating shafts, to lead away and diffuse above and spread about the deleterious vapours which it is proved the simple, and less expensive works do not generate. When the manure which has been detained, decomposed, and deteriorated at the expense of the inhabitants, arrives, after storms or flushings, at the outfall, its direct application by quick and economical power, is too ample and far too cheap. It is to be arrested and spread out into large sewer reservoirs, there to be subjected to an expensive chemical treatment, which precipitates a portion to be converted into a solid form; which solidified manure must again be put into water, for the development of such fertilising powers as it may contain, the highest of which are not pretended to contain as much as is thrown away on the original solution. At the meeting of the Health section of the Association for the Advancement of Social Science, I asked a projector who brought forward a plan of this species, had he seen the works tried on the same principle at St. Thomas's, Exeter, which had been abandoned. No, he had not. Had he examined those tried at Croydon and abandoned? No, he had not. Had he examined those nearer, at the works at Leicester, the solidified manure of which had not succeeded; or others on the like plan,—which Mr. Pigott Smith, the surveyor of Birmingham, not inaptly described as an elaborate machinery for obtaining the bran, and throwing away the flour,—a description which a close examination and report by Professor Hofmann, of the College of Chemistry, and other chemists, fully justifies? No; he had not. But he will still persevere, and in despite of the proved elementary principles of success on the one side, and of failures on the other, large capital is invested,—in the instance of Leicester, double that which would have sufficed for a direct application,—in the face of such experience, as that for half a century at Edinburgh, and of the continued letting of inferior applications at £20 and £30 an acre per annum. Agitation is maintained for the depreciation of the principle and practice of liquified applications, and the exaltation of applications of the solidified manufactures, of which it has been repeatedly announced that the records of the Royal Agricultural Society do not furnish one solitary instance of success.

Where these intermediate applications are proposed to be elided, and more direct applications adopted, the evidence of the elementary facts ascertained is still defied. Thus, in respect to the area required, it is now tolerably well ascertained that 100 acres will suffice for the utilisation of the sewage of 500 houses; that for the metropolis, some fifty or sixty thousand acres, about the extent of the Plumstead and the Kentish marshes, would suffice; but one plan demands nine millions of acres, whilst the official referees, more moderate, but still without any justificatory facts, demand one hundred thousand acres. On considerable experience, it is now ascertained that for the complete distributing apparatus, of pipes, hydrants, &c., for the land, leaving it free for arable as well as grass cultivation, an average expense of £5 per acre (or the average expense for permanent works, of one year's ordinary top dressing) will suffice;—that with this apparatus, thirteen or fifteen inches of liquified manure will produce as great an effect as sixty inches thrown on by the old method of submersion;—but in the face of this experience (*v. ante*), the formation of water meadows, at the expense of £12 per acre, is preferred, leading to the conversion of extensive sewer marsh surfaces, with additions of works, leading to an estimated expenditure of no less a sum than £75 per acre.

"It must not be expected," says the Archbishop of Dublin, "that reason will universally make its way. '*Medicamenta,*' says the medical aphorism, '*non agunt in cadaver.*' Those in whom indolence is combined with pride, will be induced by the one to remain in their position, and by the other to fortify it as they can." The exposition of the misdirected interests that stand in the way of science, and actively impede the progress of practical art, could only be made at much length, and I will, in conclusion, only refer to that part of M. Barral's paper wherein he alleges that the "ill repute of the Board of Health in England has especially arisen from the heavy expenses which it has imposed upon towns for the express purpose of applying their sewage to agricultural purposes, the result having rarely (never) answered the promise made by Mr. Chadwick, and that the ruin of Mr. Kennedy, of the liquid manure farm, Myer Mill, &c." Passing by the allegation of the unpopularity of the Board, who received petitions from upwards of two hundred and eighty towns for its intervention, and whose ordinary functions were exercised in the main upon voluntary applications; it is not correct to allege that Mr. Chadwick has pretended to make any personal promises whatsoever, either as to the application of sewage, or of farmyard manures. As to their productive powers, the promises really made were those contained in the evidence cited, of De Candolle, of Schwerz, and of eminent English agriculturists, of the experience at Milan, and the continued letting of the Edinburgh water meadows at £20 per acre or more. As to the mechanical powers of distribution, the promise made was mainly on undisputed trial works, easily repeatable, and on the cited facts adduced by engineers, who will be found to be of pre-eminent distinction in the comparative closeness of this expenditure to their estimates. The promises put forth on such evidence, of which all might judge for themselves, will be found to have been everywhere realised, in proportion as the evidence itself has been adhered to. Mr. Barral may judge of the sort of hands into which he must have fallen, from the fact that not a single town made any practical application of the kind whatsoever, or was known to have incurred any expenses of the kind, or was called upon or could be compelled by the Board to do so, the Act having given to it no compulsory powers for the purpose. It was, however, a matter of extensive request from local authorities that such powers should be provided to be exercised by the Board in their behalf for the removal of obstructions which still prevail against those who have mastered the subject. "Minutes of information" were prepared and issued for the guidance of voluntary efforts, such as those made by the Earl of Essex for the application of the sewage of Watford, and those by Mr. Walker for the application of the sewage of Rusholme.

I feel justified in calling upon M. Barral to name his authority for the statements above made, for I have no doubt that the source will be found befitting the feelings of exultation manifested at the obstruction or frustration of labours directed to the prevention or mitigation of some of the heaviest inflictions on mankind.

I am, &c.,
EDWIN CHADWICK.

THE SMOKE QUESTION.

Sir,—Not having had an opportunity of replying to the various observations made upon my paper on Wednesday evening last, I shall feel obliged by your inserting the following in the next week's *Journal* of the Society. I may congratulate the meeting that my paper elicited so much valuable information from the various speakers, several of whom rather misapprehended the drift of my facts and arguments; by the former both in glass furnaces and several steam-engine boilers, viz., three at the Phœnix gas works, and one at the Falcon glass works, it has been proved beyond the question of a doubt, that coke, taken fresh and dry from the gas retorts to the furnaces, has given rather more heating power at the rate of one chaldron, than one ton of small Newcastle coal, without smoke or injury to the bars or boilers.

Mr. Greaves's experience of the advantages of gas coke being inferior to mine, arises most probably from his coke not having been fresh, perhaps wet and somewhat broken by exposure and conveyance in open barges, which, I have reason to believe, would deteriorate gas coke to the extent of 15 to 20 per cent. Mr. Fothergill's remarks upon coke being inferior to coal for locomotives, refer probably to anthracite coal (or coal of that class), which is but a more close (less porous) and aggregated form of carbon than coke. Coke is usually bought (and ought to be bought) by measure. It is, however, a good check as to strength, to have a test by weight also, as, in case of its proving much less in weight than 13 cwt. per chaldron, an increased quantity ought to be allowed to the consumer. I had great difficulty in persuading Mr. Frederick Pellatt to try coke in such large proportions as 19 of coke to one of coal, but complete success attended his first week's trial, and he has never since been disappointed. If Mr. Quick and Messrs. Doulton would double their proportion, viz., two-thirds of coke, I have no doubt of its success, as the one-third bituminous coal would, I believe, have sufficient carrying power. If Mr. Stevens had noticed that my paper in no case advocates the use of coke without some small coal, his question would have been unnecessary. It is sufficient to observe that where long flues in boilers require carrying fuel, more small coal should be added to the coke. With respect to his "dissent from my general conclusion," he seems to have omitted in his calculation the gas, which very greatly exceeds in value the fuel used for its generation, and which would have made all the difference in his Dr. and Cr. account, which, however, in any case, would be no disparagement to my facts, viz., that when manufacturers can get cheap and fresh gas coke in their locality, it may be used in large or lesser proportions with economy, &c. Mr. Patrick Buchan, then present, would have stated, had he the opportunity, what he has since communicated to me by letter, that at the Crewden Iron Works, of which he is manager, in Ireland, "The coal is highly carbonaceous, burns with a yellow smoke, and contains 70 per cent of coke. Practically, we get that return from our coking ovens. For the sake of economy in carriage, we coke it and throw away its gaseous and other parts. We should use 3 tons of coal in making a ton of iron; the equivalent would be 40 to 45 hundredweight of coke, but, bearing out your observation, it really amounts to 35 to 38 cwt." So that it appears that coke for smelting iron on a large scale has been about 13 cwt., or one chaldron, against one ton of bituminous small coal, practically confirming my experiments on a large scale, for raising steam and melting glass in ordinary furnaces.

I am no enemy to the use of machinery or inventions for preventing the smoke of bituminous coal, which should be used where coke or anthracite cannot be bought cheaply. I mentioned that Messrs. Doulton have a steam-engine boiler of almost Cornish dimensions, with a fire-place in the centre, like a marine boiler, with two dampers, one for the ingress and another for the egress of the air, with ample throat, and still more ample chimney, the thick door of the furnace being perforated with numerous small holes, which separate and heat the entering air, but which, being afterwards closed by outside shutters, when the gases were burnt off from a charge of coal, the air entered only through the bars below. The heat was greater than that of a Cornish furnace, and was working ordinary coal smokelessly with a consumption only of half a ton for 10 hours daily, though the engine did the work of from 25 to 30 horses.

For house purposes the celebrated Dr. Arnott has a close stove, burning coke day and night with remarkable economy, his estimate being about one ton per annum; he has also open stoves, partly for coke and coals, which give a good heat at about two tons per annum, say one ton of each, and could be kept burning, were it necessary, all the year through smokelessly.

Should legislation ever be extended to private houses, the Doctor's principle and inventions for adapting the supply of air to the consumption of the fuel would be more largely adopted.

When small coal only was used as formerly in a glass furnace, the smoke was intensely dense, even with careful stoking, and when a charge was put on, such an immense quantity of gas and smoke was produced as for a short time checked the heat of the furnace and lowered its temperature, (as ammonia water is stated to do when converted into steam within gas retorts). The large portion of the coke used (with only a 20th portion or more of coals) checks the heat infinitely less than coal when thrown on, and no skill of the stoker is comparatively necessary, as he could hardly cause smoke with coke fuel if he desired it. Mr. Hyde Clarke is mistaken in supposing the small coal was *stale* and badly stored, as it always came from the London coal-merchants as soon as sifted, and was at once placed before the furnace for use. It appears that he (Mr. Clarke) tried coke in his establishment, for raising steam, without success; so did Mr. F. Pellatt, and did not succeed till he enlarged his furnace, &c., to the dimensions adopted by Mr. Innes, at the Phœnix Gas Works.—I am, &c.,

APSLEY PELLATT.

Staines, Dec. 5, 1857.

DRAINAGE AND UTILIZATION OF SEWAGE.

SIR,—Last year I submitted to the Sewage Commissioners certain suggestions. Moderate towns, of about fifty thousand inhabitants, could be drained by one underground sewer, and its branches. London, containing, say, three millions of people, should be subdivided into longitudinal sections, at right angles with the river, so that every section may contain about 50,000 people, as near as the undulations of ground and deviations of present channels would admit. About sixty channels would thus open into the Thames, north and south, each being discharged separately by its own individual motive power. I propose that every separate section of 50,000 inhabitants, shall disharge its own sewage into 10 or 20 tanks, say of 1,000 tons each, their tops to be on a line with the lowest level of the present outfall. Twenty such galvanized iron or timber vessels could be easily worked, *per se*, by a few common labourers. Sixty distinct tanks, of 20 tons capacity each, will take in a total average of about 1,200 tons, or about 212,800 gallons.

This will give time for the rapid precipitants to purify the water, which is to be shot off clear into the river, at an average pressure of 20ft. at low water, and of 30 feet at high tides. The sediment could be pressed out again for use.

Deluges of rain storms could, in great part, be conveyed riverwards, along many street or surface channels, and in certain localities a few existing drains could be maintained clear, for the transit of storm floods only.

It is by the variety of gases generated in the manufacture of the phosphates and ammoniates, that motive power is gained; it is by the action of these gases in close tanks that smells are abated. Bi-carbonate of magnesia is produced in the tanks, or in separate vesssels, and these materials, acids and carbonates, phosphates and ammoniates, form heavy and nearly insoluble triple phosphates, made to subside in the vats so rapidly that the clear and scentless water may be discharged into the Thames after 6 hours' subsidence of its silt. In ordinary cases, steam is the best motive force, but it contributes no *quality* to liquids. It cannot work well except by the intervention of machinery. But one or other of the gases here mentioned constitutes its own piston, to drive water down in vats and up in shafts, and to discharge pure water into rivers, whilst collecting sediment, equal to guano, on the bottoms of the vats. In some cases it is better to mingle the chemical materials and their results among liquid manures or sewage, and to force them constantly, without subsidence or delay, to rural districts for irrigation.

I am, &c., JAMES MURRAY.

MEETINGS FOR THE ENSUING WEEK.

MON. Architects, 8.
Geographical, 8½. I. Mr. Galton, "On the Exploration of Arid Countries." II. Mr. Moffatt, "Journey in the Bushman and Namaqua Land, South Africa" III. Latest Accounts of the fate of Dr. Vogel, Central Africa. IV. M. Brun-Rollet, "On the White Nile."
TUES. Civil Engineers, 8. Annual General Meeting.
Pathological, 8.
Statistical, 8.
WED. London Inst., 7.
Society of Arts, 8. Mr. John Underwood, "On the History and Chemistry of Writing, Printing, and Copying Letters, and a new plan of taking Copies of Written and Printed Documents, Maps, Charts, Plans, and Drawings."
Geological, 8. I. Mr. J. Prestwich, "Note on the Boring through the Chalk at Harwich." II. Mr. R. Godwin-Austen, "On a Granitic Boulder out of the Chalk at Croydon, and on the Extraneous Rock Fragments found in the Chalk." III. Mr. C. J. F. Bunbury, "On the genus *Neuropteris*, from the Coal Measures."
THURS. Philosophical Club, 5½.
Numismatic, 7.
Antiquaries, 8.
Chemical, 8. Rev. J. G. Macvicar, "On a new Maximum and Minimum Thermometer."
Linnæan, 8. I. Mr. Sclater, "On the Fauna of New Guinea." II. M. Fée, "On the nomenclature of the genus *Buffonia*." III. Mr. F. Muller, "Report on the Botany of the North Australian Expedition."
Philological, 8.
Royal, 8½.
SAT. Medical, 8.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, November* 27.]

Dated 3*rd November*, 1857.

2787. Stanislas' Hoga, Charlotte-street, Fitzroy-square—Improvements in electric telegraphs.

Dated 11*th November*, 1857.

2845. Peter Madden, 1, Russell-place, Dublin—Improvements in kilns for drying corn, malt, or other granular substances, part of these improvements being applicable to the screening or sifting of such substances during the process of drying.

2847. Otto William Wahl, 27, Leadenhall-street—Improvements in manufacturing farinaceous products from potatoes. (A communication.)

2851. Joshua Williams, Neath, Glamorganshire—An improvement in coupling and connecting carriages on railways.

Dated 12*th November*, 1857.

2853. James Stevenson, jun., Glasgow—Improvements in lighting apartments and passages.

2855. Stanley Webster, Bolton-le-Moors—Certain improvements in machinery or apparatus for tanning.

2857. George Tomlinson Bousfield, Loughborough-park, Brixton—Improvements in castors. (A communication.)

Dated 13*th November*, 1857.

2861. Anguish Honour Augustus Durant, Conservative Club, St. James's—An improved apparatus for husking and winnowing castor seeds for the purpose of obtaining the larger quantity and a purer kind of oil therefrom when pressed than heretofore with the outer skin or cuticle on.

Dated 14*th November*, 1857.

2863. George Haseltine, Washington, U.S.—Improvements in machinery for the manufacture of small metallic chains. (A communication.)

2865. James Henry Bennett, 8, Vambrugh-place, Leith—Improved compound safety valves.

2867. Alfred Vincent Newton, 66, Chancery-lane—Improvements in apparatus for retarding and stopping the progress of railway trains. (A communication.)

2869. John Fereday, Wolverhampton—An improved form of steam engine.

Dated 16*th November*, 1857.

2871. Jean Baptiste Donas, 36, Rue de l'Echiquier—A new optical instrument, which he calls "physioscop."

2873. John Edward Hodges, Leicester—Improvements in the manufacture of looped fabrics.

2875. James Taylor, Birkenhead—Improvements in dredging machines, which improvements are also applicable to other purposes.

Dated 17*th November*, 1857.

2877. Thomas Field, Spring place, Kentish-town—A new method or mode of, and appliances for, submerging submarine telegraph cables.

2881. William Pidding, Southwark-bridge-road—Improved manufactures and improvements in the manufacture of piled fabrics, or of mosaic or tesselated textile and other fabrics, and improvements in some of the machinery or apparatus necessary to produce them, also the application of certain existing or known machinery or apparatus for their production.

2883. Solomon P. Smith, Cresent, New York, U.S.—Constructing iron wheels for railway carriages and similar purposes.

2885. Richard Archibald Brooman, 166, Fleet-street—Improvements in gas burners. (A communication.)

2887. Edward Daniel Johnson, Wilmington-square—An improvement in the construction of fuzee watches.

INVENTION WITH COMPLETE SPECIFCATIONS FILED.

2901. Henry Davis Pochin and James Woolley, Manchester—Improvements in the manufacture of gum or dextrine from amylaceous substances.—19th November, 1857.

[*From Gazette, Dec.* 4, 1857.]

Dated 15*th October*, 1857.

2641. Henry Angelo Ludovico Negretti, and Joseph Warren Zambra, Hatton-garden—Improvements in producing graduated scales, and other signs, letters, numerals, characters, and pictorial representations, upon porcelain and other ceramic and enamelled materials, which improvements are applicable to the graduated scales of meteorological and other philosophical instruments.

Dated 19*th October*, 1857.

2675. Benjamin Garvey, Asland, New York, U.S.—Improvements in apparatus for determining position and direction on land and sea.

Dated 2nd November, 1857.

2780. Nelson Matthews, Dodworth, near Barnsley, York—Improvements in pumps.

2782. Mathieu François Isoord, Paris—Improvements in producing heat and light.

Dated 3rd November, 1857.

2788. James Mallison, jun., Bolton-le-Moors—Certain improvements in 'gassing' yarn and textile fabrics, and in the apparatus connected therewith.

2790. William Joseph Curtis, 1, Crown-court, Old Broad-street—Improvements in machinery used for slotting, boring and surfacing.

2792. Henry Kinsman Sweet, Northumberland-street, Strand—Improvements in photographic portraits and pictures. (A communication.)

2796. John Seithen, Earl-street—Improvements in machinery for cutting cork.

Dated 4th November, 1857.

2798. William Fothergill Batho, and Eugene Moritz Bauer, Salford, near Manchester—Improvements in machinery or apparatus for drilling and boring metals, and also for cutting key ways and cotter holes.

2800. James Murphy, Newport, Monmouthshire—Improvements in the permanent way of railways.

2802. Charles Edward Amos, the Grove, Southwark—An improved arrangement of steam machinery for driving rotary pumps.

2804. James Houghton, Kilburn—An improvement in braces.

Dated 5th November, 1857.

2808. Henry Bessemer, Queen-street-place, New Cannon-stret—Improvements in treating iron ores.

2810. Henry Beinhauer, Deutz, near Cologne—Improved machinery for drawing or extracting water from mines, wells, pits, or other deep places by means of suction.

2812. Heinrich Hochstaetter, Darmstadt—An improved machine for the manufacture of matches.

2814. Henry Robinson Palmer, Lambeth—An improved stamping and endorsing machine.

Dated 6th November, 1857.

2816. Robert Ker Aitchison, New North-street—An improved break, applicable to wheeled carriages.

2818. William Anderton, Ince-within-Mackerfield, Lancashire—New railway chairs.

2820. William Macnab, Greenock—Improvements in vessels propelled by screw or other similar propellers.

Dated 7th November, 1857.

2822. John Fordred, Stoke Newington—Improvements in treating and purifying water.

2884. John Adams, Queen's-road, Dalston—Improvements in revolver fire-arms.

Dated 9th November, 1857.

2826. Peter Brotherhood, Chippenham—Improvements in boilers and furnaces.

2828. Daniel Stothard, Lambeth, Joseph Jones, Southwark, David Jonas and Benjamin Woolf Jonas, Spitalfields—An improved ship's block.

2830. John Pinker, Pease-street, Hull—Improvements in governors for marine steam-engines.

2832. Alexander Parkes, Bath-row, Holloway-head, Birmingham—Improvements in the manufacture of nails.

2834. William Jekin Elwin, Dartford, Kent—Improvements in night-lights.

Dated 10th November, 1857.

2838. Charles Eugene Lecointe, Paris—A new mode for advertising.

2840. Alexander Parkes, Bath-row, Holloway Head, Birmingham—Improvements in the manufacture of tubes and cylinders of copper and alloys of copper.

2842. Josiah Harrington, 9, Glo'ster-place, Brixton-road—Improvements in apparatus for pointing pencils or marking instruments.

Dated 11th November, 1857.

2844. Henry Thompson and Samuel Thompson, Regent-street—Improvements in the construction of piano-fortes.

2846. John Richard Cochrane, Glasgow—Improvements in the treatment or manufacture of ornamental fabrics.

2848. Isaac Taylor, Stanford Rivers—Improvements in apparatus used in printing calico and other fabrics when cylinders are employed.

2850. Albert John Davies, 29, George-street, Hanover-square—A protective sandal for bathers, which may also be adapted as an auxiliary for swimmers.

Dated 12th November, 1857.

2852. Ebenezer Colcman, Dudley, Worcester—An improvement in lathes for turning bolts, screws, and other small articles in metal.

2854. Françoise Honorine Felicie Bertrand de Sivray, Paris—Certain improvements in the construction of bedsteads.

2856. William Picking, Lambeth—An improved method of, and apparatus for feeding steam-boilers with water.

Dated 13th November, 1857.

2858. William James Gifford, 23, New Millman-street—Improvements in the making, reefing, and working of sails, and in the construction and arrangement of masts, spars, and rigging, for ships and boats.

2860. William John Macquorn Rankine, University of Glasgow—Improvements in fan-blowers.

2862. Henry Bessemer, Queen-street-place, New Cannon-street—Improvements in the treating and smelting of iron ores, and in obtaining products therefrom.

Dated 14th November, 1857.

2864. George Printy Wheeler, Abbragall, near Mitcheldean, Gloucestershire—Improvements in the preparation of materials for the manufacture of paper pulp or half stuff.

2866. John Macintosh, North Bank, Regent's-park—An improvement in preparing telegraphic wire, which is coated with gutta percha, in order to render it more capable of resisting heat, and in laying down telegraph wires in the sea.

2868. Michael Henry, 77, Fleet-street—Improvements in electric and galvanic conductors, and in the mode of, and machinery for, apparatus for manufacturing the same. (A communication.)

Dated 18th November, 1857.

2889. John Tinker, Staly-bridge, Cheshire—An improved sizing matter.

2891. Frederick Ayckbourn, 4, Lyon's-inn, Strand—Improvements in bird cages.

2893. Adolphe Ambroise Salomon-Cohen, Paris—Improvements in machinery or apparatus to be employed in the manufacture of drain pipes and other like articles from plastic materials.

2895. Major Booth, Manchester, and James Farmer, Salford—Improvements in machinery or apparatus for stiffening, drying, and finishing cotten, linnen, woollen, and other woven fabrics.

Dated 19th November, 1857.

2899. Marc Antoine François Mennons, 4, South-street, Finsbury—An improved washing and drying apparatus. (A communication.)

2903. Seth Gill and Henry Newton, Liverpool—Improvements in obtaining stereoscopic pictures.

2905. William Clay, Liverpool—Improvements in the points, switches, and crossings of the permanent way of railways.

2909. John Clarke, Shiffnal—Improvements in the construction of shafts and poles for cabs, omnibuses, and other vehicles.

2911. John Cope, Birmingham,—Improvements in buttons.

2915. Clement Lawrence West, 25, Rupert-street, Haymarket—Improvements in window sashes. (A communication.)

Dated 20th November, 1857.

2917. Joseph Denton, Pendleton, near Manchester—Improvements in looms.

2921. Henry Bessemer, Queen-street-place, New Cannon-street—Improvements in the manufacture of iron and steel.

Dated 21st November, 1857.

2923. Thomas Glover, Upper Chadwell-street, Myddleton-square, and Alexander Bain, Fetter-lane, Holborn—Improvements in eletric telegraphs.

2924. Gerd Jacob Benson, Christian-street, St. George's in-the-East—An improvement in the manufacture of moulded sugar.

2927. Jean Marie Auguste Eugene Fabart, Paris—Improvements in looms for wearving.

Dated 23rd November, 1857.

2929. Samuel Riley, 1A, Victoria-terrace, Victoria-street, Manchester—An improvement in the preparation of chocolate and cocoa.

WEEKLY LIST OF PATENTS SEALED.

December 4th.

1572. Victor Blumberg.
1588. James Morris.
1590. Thomas George Shaw.
1594. Edward Hirst Hudson.
1597. Edward Edwards.
1626. Maxwell Miller.
1628. Thomas Humphrey Roberts.
1632. Etienne Lemoine.
1734. Lambert Cowell.
2034. Julius Schonemann.

December 8th.

1601. Donald Bethune.
1604. John Bickford.
1613. Rich. Archibald Brooman
1618. George Mumby.
1623. James Brown.
1629. George Sampson, Joseph Sampson, & Elijah Ledger.
1638. Daniel Joseph Daly.
1645. Joseph Whitworth.
1661. Edward Brasier.
1663. Etienne Cominal.
1664. Thomas Moreton Jones.
1667. Thomas Heaton.
1672. Frederick Levick, junior.
1718. John Dunnell Garrett.
1984. John Henry Johnson.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

December 1st.

2557. George Ferguson Wilson & John Chase Craddock.

December 2nd.

2594. Nathaniel Johnston.

December 3rd.

2624. Samuel Fisher.

December 5th.

2571. James Edward McConnell.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietors' Name.	Address.
4035	Dec. 8.	The Chain Pocket to prevent picking and cutting...	Stopford Jones.........................	75, High Holborn.